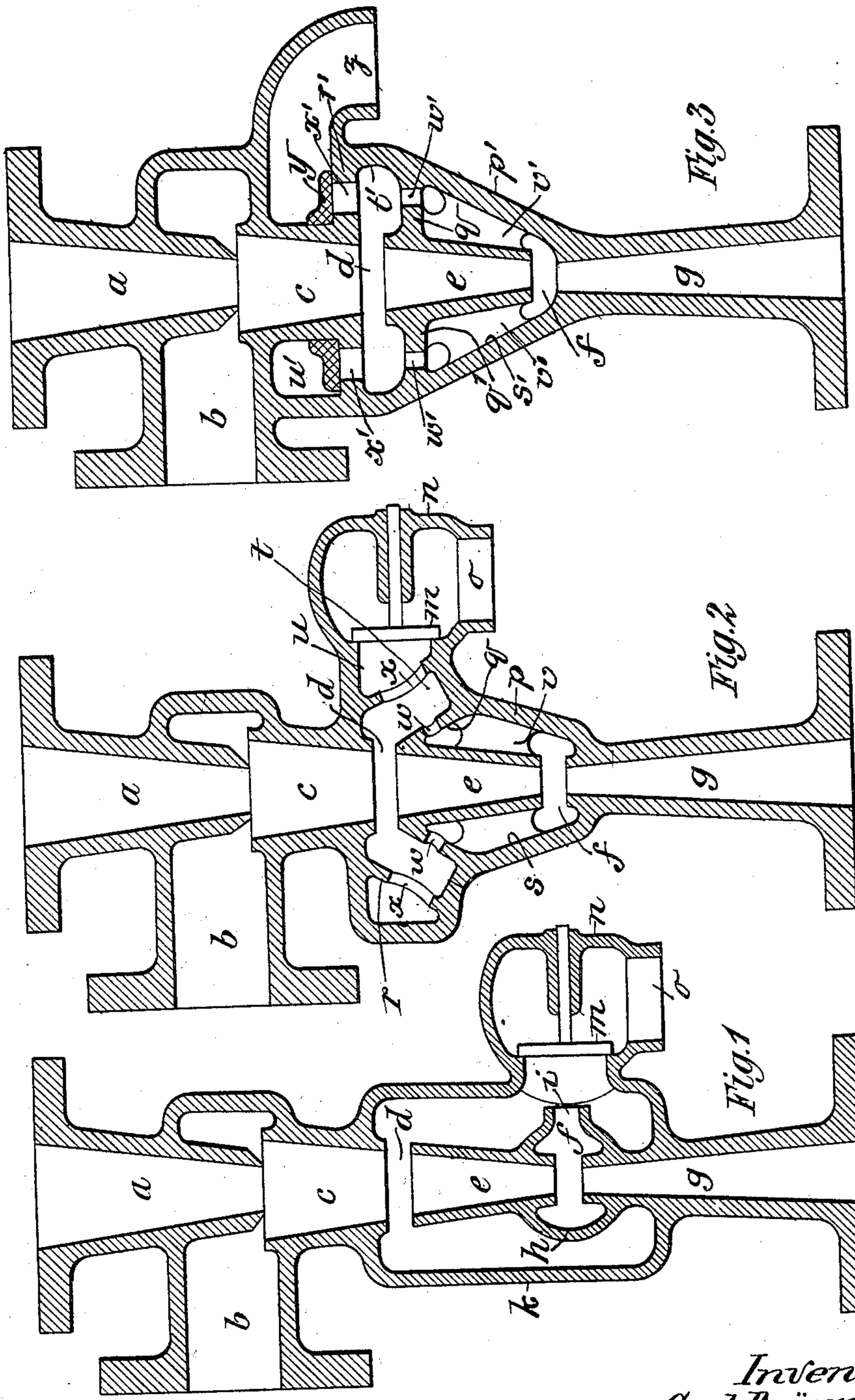
No. 679,127. Patented July 23, 1901.

C. PRÜSMANN.

INJECTOR.

(Application filed Feb. 16, 1901.)

(Model.)



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INJECTOR.

SPECIFICATION forming part of Letters Patent No. 679,127, dated July 23, 1901.

Application filed February 16, 1901. Serial No. 47,606. (Model.)

To all whom it may concern:

Be it known that I, CARL PRÜSMANN, a subject of the Emperor of Germany, residing at Magdeburg, in the Empire of Germany, have invented a certain new and useful Injector, of which the following is a specification.

My invention relates to improvements in injectors whereby their starting action is rendered more certain; and the objects of my improvements are, first, to provide the mixing-nozzle with two annular openings which are in communication with each other, so that the passage of steam through one of them exerts an influence upon the other, and, second, to provide means for producing one or several subsidiary steam-jets outside the mixing and delivery nozzles, whereby the steam passing through the one annular opening is caused to exert such an influence upon the other annular opening as to produce the suction of the liquid to be injected. I attain these objects by the injectors illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view of an injector which is so constructed that on starting a single subsidiary steam-jet is formed at right angles to the axis of the mixing and delivery nozzles. Fig. 2 is a longitudinal sectional view of another mode of execution of the injector, in which on starting several subsidiary steam-jets are formed around the axis of the mixing and delivery nozzles; and Fig. 3 is a longitudinal sectional view of a further mode of execution of the injector, in which on starting an annular subsidiary steam-jet is formed concentric with the axis of the mixing and delivery nozzles.

Similar letters refer to similar parts throughout the several views.

In Fig. 1 the steam is introduced through the steam-nozzle *a* and the water or liquid to be injected through the supply-pipe *b*. The mixture of both is, as usual, sent through the mixing-nozzle and the delivery-nozzle to the boiler or somewhere else. The mixing-nozzle is divided into two distinct nozzles *c* and *e* by the annular opening *d*. The other annular opening mentioned above is arranged at *f*, between the narrower mixing-nozzle *e* and the delivery-nozzle *g*. The two latter nozzles are connected by the casing *h*. The wider mixing-nozzle *c* is connected with the delivery-nozzle *g* by the casing *k*, surrounding the narrower mixing-nozzle *e* and the casing *h*. The casing *k* is further connected with the box *n*, which terminates in the overflow *o* and contains the non-return valve *m*. The casing *h* is provided with an opening *i*, whereby the two annular openings *d* and *f* communicate with each other.

On starting the injector the steam alone enters it by the steam-nozzle *a* and the mixing-nozzles *c* and *e*. In case the injector is connected with a boiler or a similar closed vessel of course the steam cannot enter the delivery-nozzle *g*, but gets through the annular openings *d* and *f* into the cavities of the casing *k* and *h*, whence it can easily escape after opening the non-return valve *m*.

As is well known, the shape of the steam-nozzle and the mixing-nozzles *c e* is of vital importance for the action of the injector. If the steam-nozzle *a* were shaped inside about as a cylinder or made divergent toward the mixing-nozzle *c* and if the mixing-nozzles *c* and *e* were shaped inside as a strongly-truncated cone, the steam coming from the steam-nozzle *a* would quickly stretch out and a comparatively large part of it would escape already through the first annular opening *d*. An injector of such a construction would, it is true, present the advantage that it would suck the liquid very well, because the steam encounters less resistance in the mixing-nozzle and escapes much easier; but after the start such an injector would not inject the liquid with safety, since whirls are likely to occur in the mixing-nozzle. If, on the contrary, for the purpose of rendering the action of the injector reliable the steam-nozzle *a* were shaped inside as a strongly-pointed cone, the steam-jet would be so much contracted as to stretch out only in the narrower mixing-nozzle *e* and meet its walls shortly before the second annular space or outlet *f*. Then it may be that little or no steam escapes through the first annular opening *d* and that possibly the steam-jet may suck air or steam out of the cavity of the outer casing *k* through the first annular opening *d*. Such an injector would present the disadvantage that the suction of the liquid on starting is

rendered difficult. The injector could not start if live steam, for example, were introduced into the steam-nozzle *a*. My invention relates to steam-injectors of the latter kind—*i. e.*, to those injectors in which for the purpose of obtaining a reliable action of the injector the steam-nozzle *a* is made strongly convergent, so that no considerable amount of the steam could escape through the first annular opening *d*, as is required for the normal injection of the liquid. As already stated, my invention comprises besides the two annular openings *d* and *f* also means by which the injector is enabled to start—*i. e.*, to suck the liquid with certainty. For this purpose the steam escaping through the second annular opening *f* on the start of the injector is not conducted immediately to the overflow *o*, but is collected and so directed as to form a subsidiary steam-jet, which exercises an influence upon the first annular opening *d* by creating a vacuum. Then steam will escape also through the first annular opening *d* and go along with the steam of the subsidiary jet to the overflow. Thus the steam will act much in the same manner as in the injectors described above as provided with cylindrical or divergent steam-nozzles and with mixing-nozzles in the shape of strongly-truncated cones. Instead of the one subsidiary steam-jet also several subsidiary steam-jets may be formed for the purpose named.

In the injector shown in Fig. 1 the steam escaping through the second annular opening *f* on the start of the injector is first collected in the inner casing *h* and then caused to escape through the opening *i* in the shape of a divergent jet at right angles to the axis of the steam mixing and delivery nozzles and toward the non-return valve *m*. This subsidiary jet stretches out into the casing *h* immediately before the non-return valve *m*, and after opening the latter the steam-jet will exercise its influence upon the first annular opening *d* by creating a vacuum within the outer casing *k*. The liquid will thereby be sucked and conducted through the supply-pipe *b* to the mixing-nozzle *c* to be mixed therein with the steam. When the mixture of the liquid and the condensed steam is forced, as usual, into the delivery-nozzle *g* and thence to the boiler or somewhere else, the valve *m* will be closed by the pressure of the air from without. The injector will now be in its acting condition.

In the injector shown in Fig. 2 the wider mixing-nozzle *c* is connected with the delivery-nozzle *g* by means of the casing *p*. The cavity of the latter is divided by the two annular walls *q* and *r* into the three cavities *s*, *t*, and *u*, of which the cavity *s* communicates with the second annular opening *f*, the cavity *t* with the first annular space or outlet *d*, and the cavity *u* with the cavity of the box *n* and the overflow *o* as soon as the non-return valve *m* is opened. The narrower mixing-nozzle *e* is supported by the dividing-wall *q* and the ribs *v v*. In the dividing-wall *q* several narrow openings *w* are provided and in the dividing-wall *r* a like number of wide openings *x* in opposition to the narrow openings *w*. On starting the injector the steam coming from the steam-nozzle *a* will escape first through the second annular opening *f* into the cavity *s*. From there it escapes through the apertures *w* in several jets across the annular space *t*, through the apertures *x x* into the cavity *u*, and thence after opening the non-return valve *o* to the overflow. The several subsidiary steam-jets will create a vacuum in the cavity *t*, so that steam will escape also through the first annular opening *d* and the liquid will be sucked.

In the injector shown in Fig. 3 the subsidiary steam-jet is annular in shape and formed in the following manner: The supply-chamber is connected with the delivery-nozzle *g* by means of the casing *p'*, which surrounds the two mixing-nozzles *c* and *e* and carries the narrower mixing-nozzle *e* by means of the ribs *v' v'*. The cavity of the casing *p'* is again divided by the dividing-walls *q'* and *r'* into the three cavities *s' t' u'*. Of the latter the cavity *s'* communicates with the second annular opening *f*, the cavity *t'* with the first annular opening *d*, and the cavity *u'* with the overflow *z*. In the dividing-wall *q'* the annular narrow aperture *w'* and in the dividing-wall *r'* the annular wide aperture *x'* are provided. The cavity *u'* is arranged as a chamber for the annular non-return valve *y*. It will now be evident that on starting the injector the annular subsidiary steam-jet will be formed by the steam escaping from the cavity *s'* through the annular aperture *w'*, across the cavity *t'*, and through the annular aperture *x'* into the cavity *u'* after opening the non-return valve *y*. The effect of this annular subsidiary steam-jet upon the first annular opening *d* will be much the same as that of the subsidiary steam-jets described with reference to Figs. 1 and 2.

I do not limit myself to the particular constructions of the injector shown on the accompanying drawings. In Figs. 1 and 2 the non-return-valve boxes *n n* are assumed to be cast in one piece with the casings *k* and *p*, respectively, and the guides for the non-return-valve shafts for the purpose of simplifying the illustration of the invention. In reality of course these parts will have to be so constructed as to facilitate the putting together of the parts. This can be done in various known manners, which need not be described here. The same may be said of the construction shown in Fig. 3, where no provisions are shown for introducing the annular non-return valve *y* into the cavity *u'*.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In an injector, the combination with two openings in the mixing-nozzle for the escape of steam, of means for producing a sucking effect through one of the openings upon the

liquid by the steam escaping through the other opening, substantially as set forth.

2. In an injector, the combination with two openings in the mixing-nozzle for the escape of steam, of means for producing the sucking effect by injecting the steam escaping toward the overflow the same as in a divergent nozzle, substantially as set forth.

3. In an injector, the combination with two openings in the mixing-nozzle for the escape of steam, of means for producing the sucking effect by injecting the steam escaping toward the overflow the same as in several divergent nozzles, substantially as set forth.

4. In an injector, the combination with two openings in the mixing-nozzle for the escape of steam, of means for producing the sucking effect by injecting the steam escaping toward the overflow the same as in several divergent nozzles arranged around the axis of the mixing-nozzle, substantially as set forth.

5. In an injector, the combination with two openings in the mixing-nozzle for the escape of steam, of means for producing the sucking effect by injecting the steam escaping toward the overflow the same as in an annular divergent nozzle arranged around the axis of the mixing-nozzle, substantially as set forth.

6. An injector, having walls forming a chamber, and a mixing-nozzle therein, such nozzle being divided to form two openings through which the motive fluid may pass, for the purpose specified.

7. An injector having walls forming a chamber with delivery and overflow orifices, a mixing-nozzle in the chamber, such nozzle being divided to form two openings through which the motive fluid may pass, for the purpose specified, and additional walls forming a second chamber within the first and inclosing the second space in the mixing-nozzle, said second chamber having an orifice opening into the first chamber and juxtaposed to the overflow-orifice thereof.

8. An injector having walls forming a chamber, a mixing-nozzle therein, such nozzle being divided to form two openings through which the motive fluid may pass, and means for causing the steam from one opening to exert a sucking influence upon the other opening, for the purpose specified.

9. An injector having walls forming a chamber, such chamber having an overflow-orifice therein, a mixing-nozzle within the chamber, such nozzle being divided to form two openings through which the motive fluid may pass, and additional walls forming a second chamber within the first chamber and surrounding one of the said openings between the sections of the mixing-nozzle, the second chamber having a discharge-orifice adjacent to the overflow-orifice of the first-named chamber.

10. An injector having walls forming a chamber, said chamber being provided with an overflow-orifice, an outwardly-opening valve commanding the orifice and adapted under certain conditions to be closed by atmospheric pressure, a mixing-nozzle within the said chamber, said nozzle being divided to form two openings through which the motive fluid may pass, and additional walls forming a second chamber surrounding one of the said openings between the sections of the mixing-nozzle and the said second chamber having a discharge-orifice adjacent to the overflow-orifice of the first chamber, for the purpose specified.

11. An injector having walls forming a casing provided with an overflow-orifice therein, and a mixing-nozzle within the chamber, said nozzle being divided to form two openings between which the motive fluid may pass.

12. An injector having walls forming a chamber provided with an overflow-orifice, an outwardly-opening valve commanding the overflow-orifice and adapted under certain conditions to be seated by atmospheric pressure, and a mixing-nozzle within said chamber, the nozzle being divided to form two openings through which the motive fluid may pass.

13. An injector, comprising walls forming a casing provided with an overflow-orifice, an outwardly-opening valve commanding said orifice and adapted under certain conditions to be seated by atmospheric pressure, a mixing-nozzle within said chamber, the nozzle being divided to form two openings through which the motive fluid may pass, and means within the chamber for causing the fluid from one of said openings to produce a sucking effect upon the other opening, for the purpose specified.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

CARL PRÜSMANN.

Witnesses:
CARL OSTERMANN,
M. J. BAEHR.