(Model.)

L. SCHUTTE.

STEAM JET APPARATUS.

No. 312,170. Patented Feb. 10, 1885.

FIG. 1

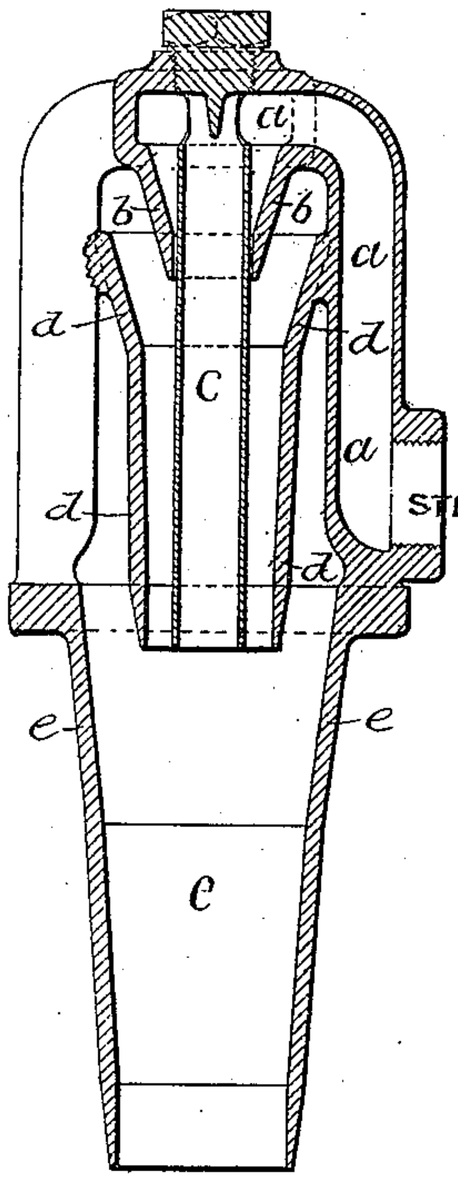


FIG. 3

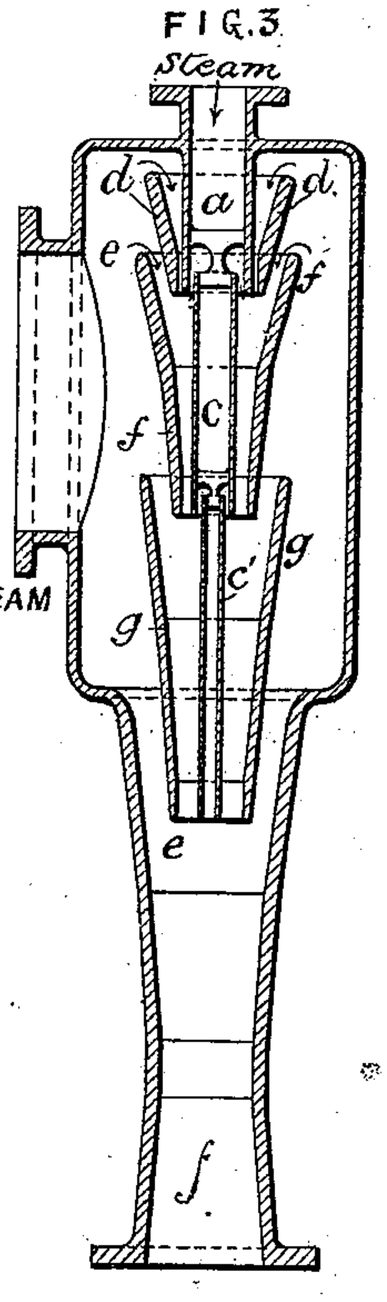


FIG. 2

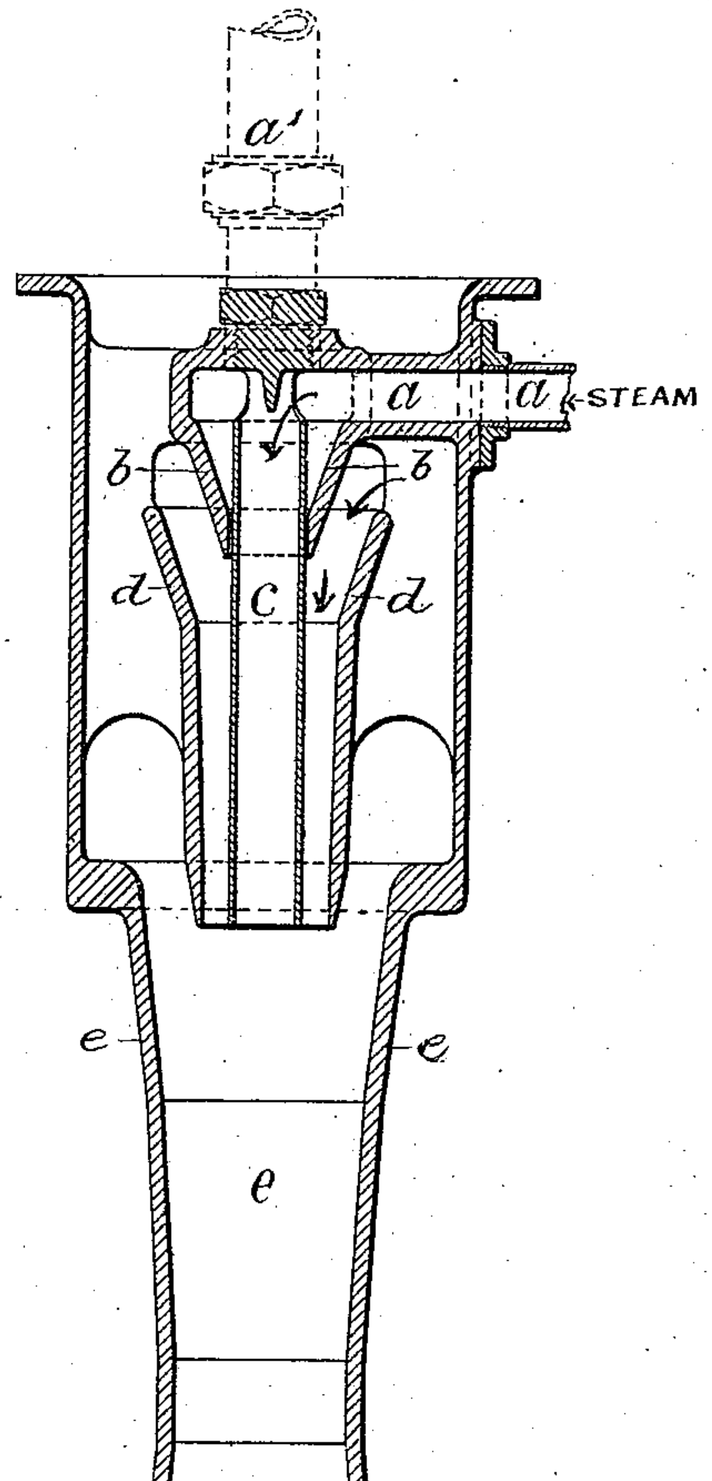


FIG. 4.

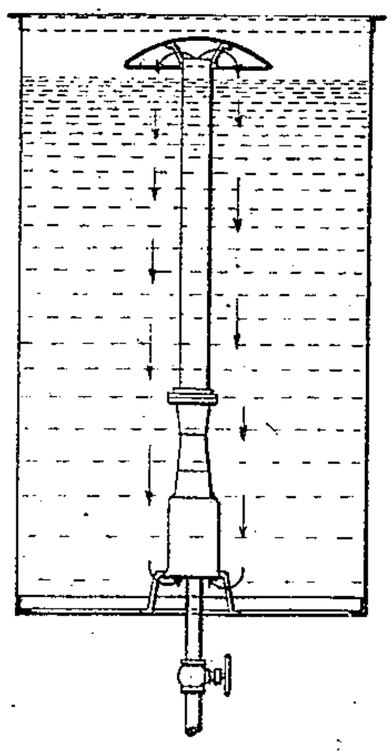


FIG. 5.

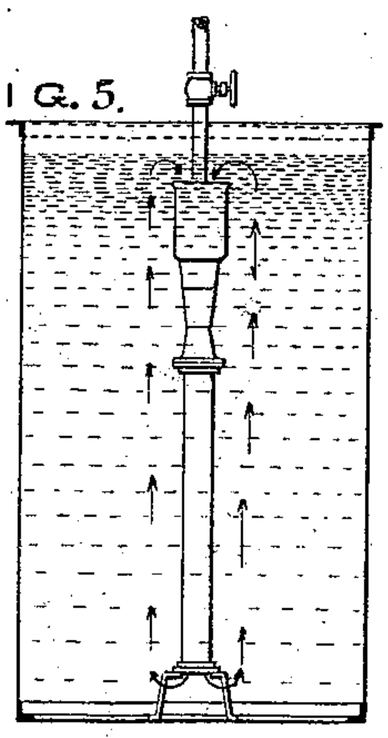
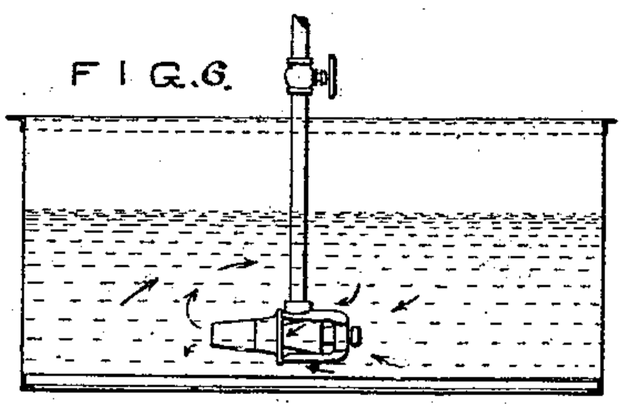


FIG. 6.



WITNESSES

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STEAM-JET APPARATUS.

SPECIFICATION forming part of Letters Patent No. 312,170, dated February 10, 1885.

Application filed September 8, 1884. (Model.)

To all whom it may concern:

Be it known that I, LOUIS SCHUTTE, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain Improvements in Steam-Jet Apparatus, of which the following is a specification.

My present invention relates to the admixture of steam with liquids or fluids for the purpose of imparting motion to the mixture, and of forcing the same, when required, against pressure.

The admixture of steam and water is readily accomplished by ordinary forms of injectors when the water is of sufficiently low temperature to cause a rapid condensation of steam at the faces of contact with the water, provided there is not sufficient time for the velocity of the steam to become converted into pressure. If, however, the temperature of the water is high, the steam will not condense or combine with the water promptly, but will expand beneath the water and rise bodily to the surface, producing in its upward course explosive sounds caused by the partial collapse and condensation of the steam-globules, while the steam which reaches the surface escapes without transmitting its heat to the water, thereby producing a loss. To avoid these objections, suitable guides and subdivisions must be provided to insure suitable contact-surfaces between the steam and water.

The principle on which my apparatus is based is that of compelling the steam to remain sufficiently long in contact with the liquid or fluid to cause a thorough admixture of the two and an equalization of their temperature. For this purpose I utilize in part the initial force or pressure of the steam by establishing a jet or current which, by its velocity, carries the mixture in the desired direction, and thereby prevents the steam from effecting its escape in other directions affording less resistance, and partly by surrounding the steam with annular jets or streams of the liquid or fluid, which in this form permits the transmission of heat to take place readily.

Referring to the accompanying drawings, Figures 1, 2, and 3 are longitudinal central sections of my apparatus in slightly-different forms. Figs. 4, 5, and 6 are views illustrating a few of the numerous methods in which the same may be applied.

In Figs. 1 and 2, *a* is a passage for the admission of steam, which is delivered therefrom through the long central nozzle *c*, and also through the shorter nozzle *b*, surrounding the same. The two steam-nozzles *b* and *c* are encircled by a third nozzle, *d*, the mouth or receiving end of which is preferably made of a flaring form, and the delivery end of which is arranged to enter a large conical nozzle, *e*. The steam issuing through the nozzle *b* meets the fluid entering around said nozzle into the nozzle *d* in the form of an annular jet and induces the same in a forward direction, so that the mixture is discharged in the form of an annular jet around the outside of the central steam-jet into the nozzle *e*, where a further admixture occurs with the steam delivered through the central nozzle. This central jet gives additional impetus to the current, and insures a thorough assimilation of the steam and the water, which are delivered through the nozzle *e* at a temperature but slightly higher than the surrounding body, with which an exchange of temperature will readily take place.

The two apparatus represented in Figs. 1 and 2 are substantially identical in construction and operation, the only difference in construction being that in Fig. 2 the water-inlets are surrounded by a case or jacket, and the discharge-nozzle expanded at the delivery end to form what is commonly known as a "pressure-cone," *f*, whereby the apparatus is adapted to deliver against counter-pressure.

When constructed as in Fig. 2, the apparatus is adapted for connection at its delivery end with a conducting-pipe.

It will generally be found that the number of nozzles and of admissions for the steam and liquid or fluid represented in Figs. 1 and 2 are sufficient for all purposes; but the principle may be carried out *ad infinitum* by dividing the steam into any desired number of annular jets and providing a corresponding number of admission-openings for the liquid or fluid. For the purpose of illustrating this fact, I present in Fig. 3 another form of the apparatus, in which the steam-nozzle is made in three sections, *a c c'*, of successively-decreasing diameter, with annular outlets between them. This nozzle is surrounded by the three nozzles *d*, *f*, and *g*, each of which enters the mouth of

the next. It will be observed that the arrangement is such that a series of annular steam-jects are brought into contact with a series of annular water-jets, and that each jet is propelled forward in such manner as to join or merge into the next jet in advance. The temperature and speed of the current established through the apparatus is constantly augmented from the interior by the successive admissions of steam, while by the successive admissions of liquid or fluid the speed and temperature at the discharge may be regulated to suit the requirements of the apparatus. The transmission of the speed and temperature from the inside outward will extend to the whole length of the apparatus.

While I have represented in Figs. 1 and 2 a steam-passage entering from one side, it is to be understood that it may be arranged in line with the axis of the nozzles, as represented by dotted lines at *a'* in Fig. 2, or otherwise arranged at will.

In Fig. 4 I have represented the form of apparatus shown in Fig. 2 in an inverted position, connected to the lower end of a circulating-pipe, and located in a reservoir containing fluid.

The apparatus being open at the two ends, the admission of steam will be followed by a circulation in the direction indicated by the arrows.

Fig. 5 represents a similar application of the apparatus, except that the position is inverted, the circulating-pipe being extended downward instead of upward.

Fig. 6 represents the apparatus shown in Fig. 1 arranged in a horizontal position in a fluid-reservoir.

These various forms of apparatus, which consist of a series of concentric nozzles discharging one into another, and designed to be actuated wholly or partly by the inductive action of a jet or current delivered through them under pressure, are commonly known in the art as "jet apparatus" and "steam-jet apparatus," and it is with this meaning that such expressions are employed herein.

Having thus described my invention, what I claim is—

1. In a steam-jet apparatus, a central steam-admission nozzle provided with two or more annular discharge-openings at different points in its length, in combination with external nozzles discharging one into another, substantially as described and shown.

2. In a steam-jet apparatus, the central steam-admission nozzle having the annular discharge-openings of successively smaller diameter, in combination with the surrounding nozzles *d e*, &c.

3. In a steam-jet apparatus, a steam-admission nozzle with two or more concentric discharge-openings, in combination with external fluid or liquid admission nozzles, arranged as described, so that each of the external nozzles will deliver an annular fluid-jet between the preceding steam-jet and the succeeding fluid-jet.

4. In a steam-jet apparatus, the steam-inlet nozzle provided with two or more concentric discharge-openings all communicating with a single inlet, in combination with the external liquid or fluid admission nozzles, the first arranged to discharge in annular form between the steam-jet and the second fluid-jet, and so on throughout the series.

5. In a steam-jet apparatus, a series of successive annular concentric steam-discharge mouths combined with concentric successive fluid-inlet nozzles arranged each to deliver an annular jet around a steam-jet and within the next fluid-jet, whereby extended contact-surfaces are secured between the steam and the fluid.

In testimony whereof I hereunto set my hand this 7th day of August, 1884, in the presence of two attesting witnesses.

LOUIS SCHUTTE.

Witnesses:
DANIEL HILDRETH,
FRANK SPIELIN.