W. MONTSTORM.

Air-Injectors for Aero-Steam Engines.

No. 168,678.

Patented Oct. 11, 1875.

Fig. 1.

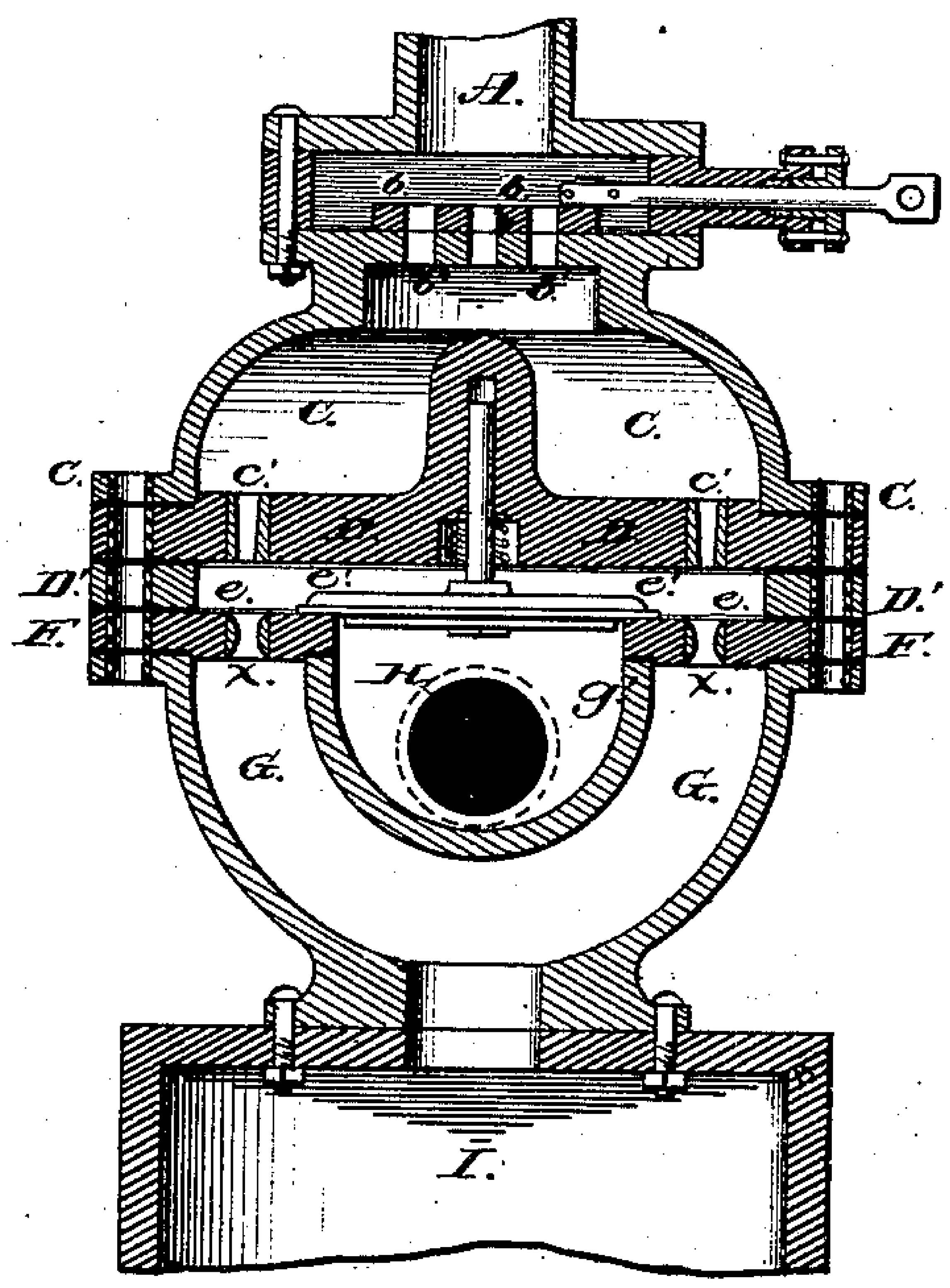


Fig. 2.

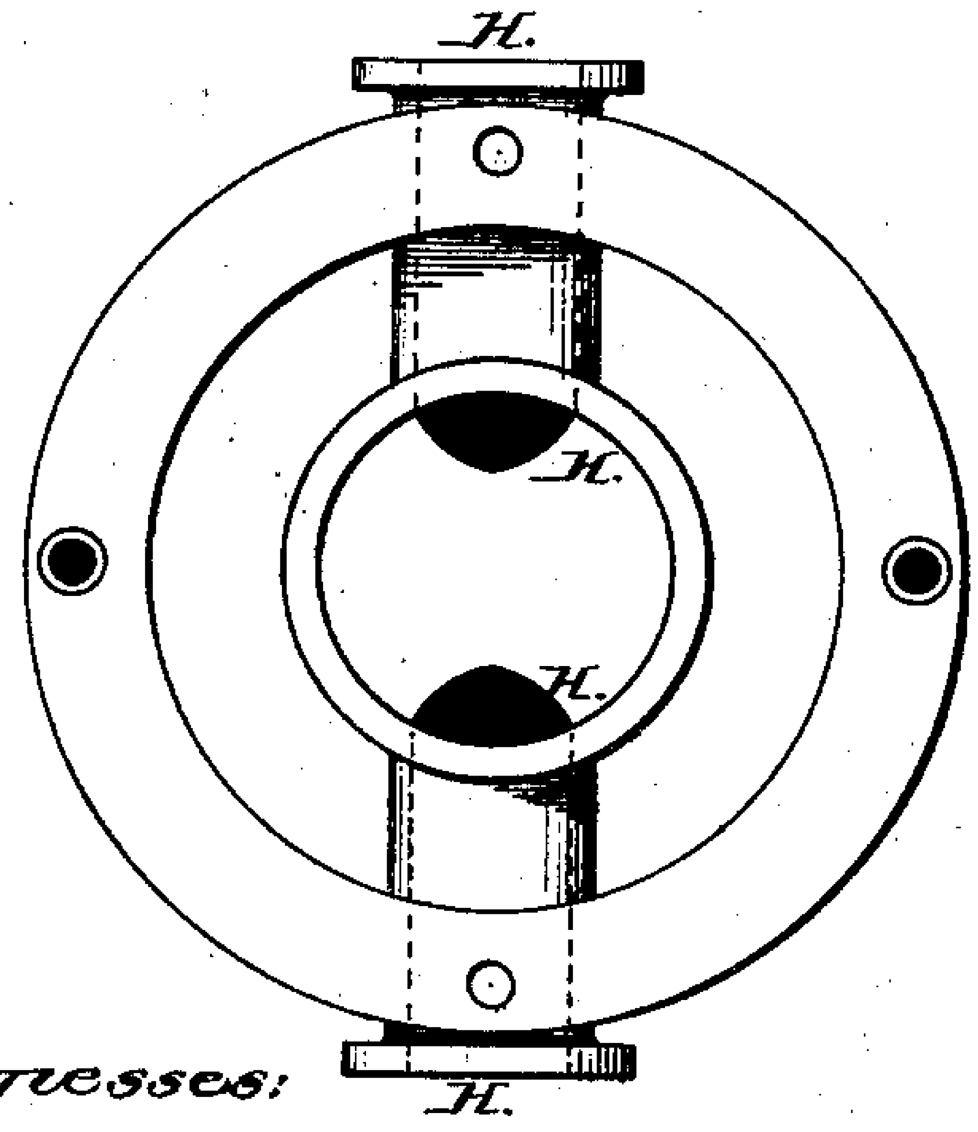
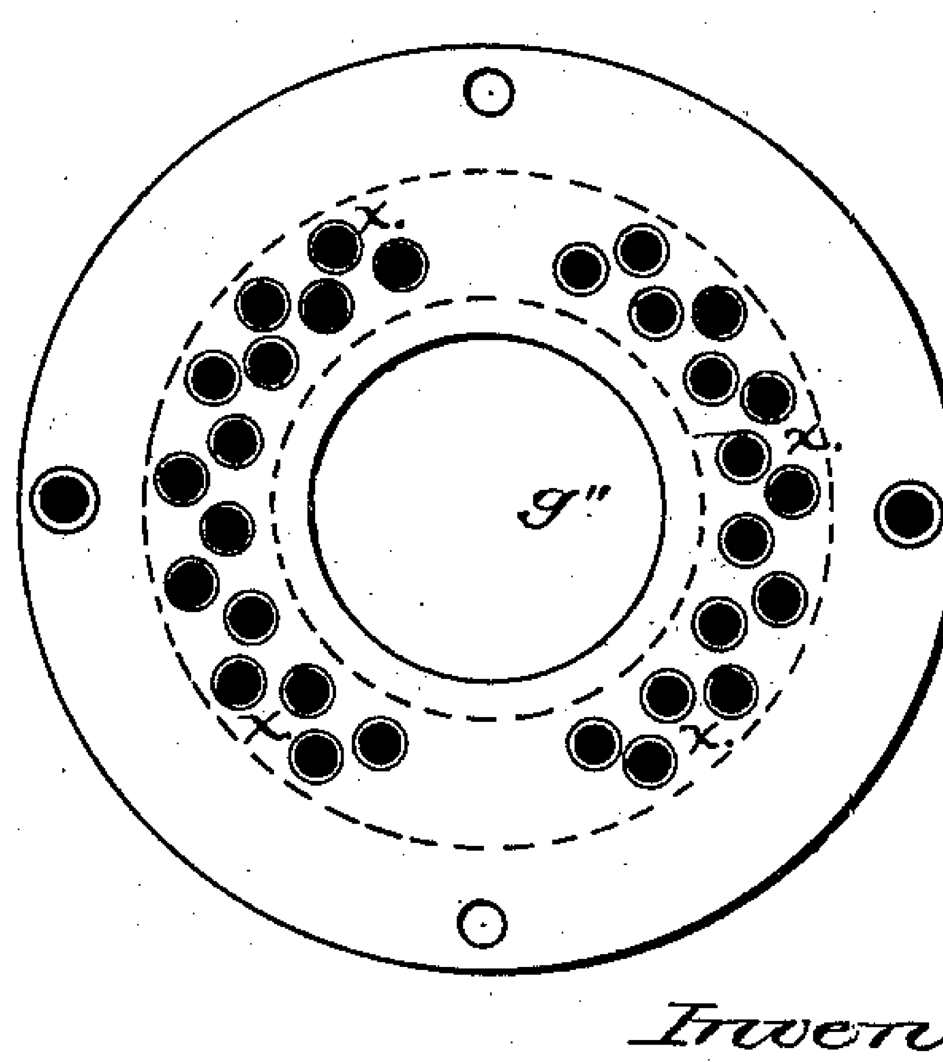


Fig. 3.



Witnesses:

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WILLIAM MONT STORM, OF NEW YORK, N. Y., ASSIGNOR TO HIMSELF AND WILLIAM L. WILLIAMS, OF SAME PLACE.

IMPROVEMENT IN AIR-INJECTORS FOR AERO-STEAM ENGINES.

Specification forming part of Letters Patent No. **168,678**, dated October 11, 1875; application filed April 24, 1874.

To all whom it may concern:

Be it known that I, WILLIAM MONT STORM, of the city and State of New York, have invented a certain apparatus, which I call an "Air-Injector," for use with aero-steam engines, of which the following is a specification:

Figure 1 of the accompanying drawings represents a vertical mid-section of the device, which, as a whole, is to be mounted upon the valve-chest of an engine, or upon the top of a receiving-vessel, (a portion of which is shown,) which is, in turn, to be mounted upon and communicate with the valve-chest of the given engine.

Let A represent a portion of the ordinary steam-pipe communicating with the valve-chest of a steam-engine, but having interposed along with my device, and, as I may say, constituting a part of the latter, a "gridiron" slide-valve, *b b*, having four valve-bars and three openings, corresponding with openings *b′ b′ b′* in its seat beneath.

The valve is shown open, and so constructed and so operated by the engine as to open and close again by a movement in one direction, to supply steam for one stroke of the engine, and similarly open and close on being moved in the opposite direction, to admit and cut off steam, supplying the corresponding opposite stroke of the piston, all as will be understood.

The steam, on passing through the ports *b′*, enters an expanded circular chamber or "bonnet," C, from which it passes in jets through cone-like apertures C′ in a circular metal plate or disk, D. The steam-jets, in issuing from apertures C′, pass with great velocity across the inclosed space *e*, and through corresponding apertures *x x* (of the form of the *vena contracta* of Newton) in another circular plate, or rather ring-disk, F—a plan view of the upper face of which and the arrangement of its apertures is shown by Fig. 3. F is tightly seated upon a globular double cup, one cup within another, with a space, G, between them, into which the steam enters and diffuses after passing through F. Through F is a circular opening, as large, or nearly so, as the top of the inner cup *g′*. This opening is shown also by *g″*, Fig. 3. Within the space *e*, between D and F, is a light disk-valve, *e′*, closing the opening *g″* over the top of the inner cup *g′*. Communicating with the inner cup, and extending across the space G, and out through the outer cup on each side, is a large pipe or conduit, H. (See Figs. 1 and 2, Fig. 2 being a plan view of the so-called "double cup.")

It may be scarcely necessary to say that C D F and the double cup are tightly bolted together, with packing between. The action of the steam-jets (by the known laws affecting the confluence of currents) draws the air from *e*, projecting it through the apertures *x* into the mixing-space G. The space *e* is thus being exhausted, and *e′* is lifted by the greater outside pressure, and a supply of air to *e* thus flows in while the jets are flowing, and as the cut-off *b* closes, the air-valve *e′* closes also, preventing the escape of steam outward, as will be understood.

As the friction of steam passing through contracted apertures tends to loss by condensation, particularly if the apertures are through a good conductor of heat and electricity, I make each aperture C′ through a non-conducting bushing let into the plate D, as shown; but, besides the negative advantage of thus preventing loss, I attain an important positive advantage by the use of the non-conducting bushings, as about to be explained.

As evinced in the hydro-electric machine, jets of steam issuing, at a high velocity, through apertures in different substances, classed as "non-conductors" of electricity, develop electricity of different degrees of intensity, and I may avail myself of such (non-conducting) material as shall develop in the jets electricity in that degree that shall be found by experience to produce the best result in the following relation: The electricity of each jet will act upon the surrounding air by induction, drawing it forcibly toward it, (and, perhaps, into it to a certain extent,) or, as it were, forming of it continuously a sheath, passing with it through the apertures *x* into G. Thus more air will be injected into the latter than if the jets were electrically neutral.

Disk F I propose to make, as a whole, of annealed glass; but if of metal, then the apertures x should also be through bushings of non-conducting material, and probably of a substance as nearly neutral as may be, in regard to the developing electricity by the passage of the given jet through it. Disk D is electrically insulated from C by a packing-ring of varnished india-rubber canvas, or its equivalent, and in like manner is insulated from the ring D′, interposed between it and disk F. D′ is in like manner insulated from F. I have anticipated making the ring D′ compound, so that by the removal or insertion of one or more layers of it I may be able to vary the space between the steam-jet holes in D and the jet-receiving holes in F. The latter, F, is, in like manner, insulated from the double cups. The facing of the air-valve e' is of similar material to insulate it from F, and perhaps it would be well if the stem of the valve worked in a non-conducting bushing in D, or that the stem of the valve was set into a non-conducting hub in the valve itself. The bolt-holes through the flanges of C D F, the double cup, and the ring D′ are all bushed with a non-conducting material, and the clamping-bolts are to have non-conducting washers under their heads and nuts, to retain the insulation of the parts from each other, all as will be understood.

The object of these insulations is to prevent the dispersion from the disks D and F of the electricity with which they may become charged from the jets, despite of the non-conducting bushings, for this dispersion would be a corresponding tax and loss of expansive energy of the steam.

Other things equal, the action of the jets will be more efficient when an engine is running at high speed in lieu of a low one, as the resistance to their entrance into G is more rapidly relieved, as will be understood.

Again, as the best result is obtained from combined air and steam by working it on the expansion principle—cutting off, say, at one-fourth of the stroke—and as, at this point, the piston will not have attained its maximum velocity, and as its velocity is less and less back to the dead-point, now, to the end that the jets may flow with full force as the valve b is suddenly opened, and as the piston is still at the dead-point, I employ the receiving-chamber I—say of one-fourth the contents of the cylinder—into which the admixed air and steam may flow, relieving the jets from comparatively great resistance till the piston has acquired some speed, and is with corresponding rapidity making space in the cylinder to receive the admixed air and steam, as will be understood. Though valve b may close early in the stroke of the piston, the chamber I remains open to the cylinder till the end of the stroke; therefore the pressure in the former, as valve b opens at the commencement of the ensuing stroke, will be at a minimum, as compared to the pressure in the steam-pipe and boiler, and the resistance to the flow of the jets will be at a corresponding minimum. It would probably be of advantage if the receiver I were electrically insulated from the cylinder or main valve-chest.

I have anticipated working valve b so that it should open and close several times for each stroke of the piston, thus making the jets intermittent till finally stopped for the remainder of the stroke, the idea being that a greater plenum of air would fill space e during the intermission of the jets; but the advantage of this is doubtful.

I should also remark that the air-injector would act even if valve b were dispensed with, and the flow of steam through D were continuous, or, at least, until stopped, perhaps, by a cut-off between the apparatus and the cylinder; but the action of the air-injector in such case would not be nearly so efficient. I may also apply like remarks in regard to plate F, the openings through which, in lieu of being a series of jet-receiving apertures, might be a continuous opening, and this would be partially tantamount to dispensing with it altogether; but the efficiency of the air-injector would be very greatly reduced.

Should it be found in any given case that as valve b closed any portion of steam escaped through the air-valve e' while it was closing, light disk check-valves could be applied at the entrances of the air-conduits H, whose mouths could be enlarged, so as not to obstruct free entrance of the air.

I have anticipated that a greater power at like cost might be attained by supplying cup g' with air moderately compressed, which may be done, among other ways, by making conduits H communicate with a receiver, into which air is compressed either by a "donkey-pump," or, say, a detached pump driven by the engine.

I have further anticipated reheating the admixed air and steam in the receiver I by means, say, of a gridiron coil of tubing within it, such coil communicating, by its lower extremity, with the water in the boiler, and by its upper extremity with the steam-space of the boiler, or with a "superheater" communicating with it.

I claim—

The combination of disks D and F, provided with coincident orifices C′ and x, the ring D′, which forms the space e, and the check-valve, substantially as described.

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Witnesses:

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