W. E. PRALL & D. A. BURR.

STEAM VACUUM PUMP.

No. 172,654. Patented Jan. 25. 1876

Fig. 1

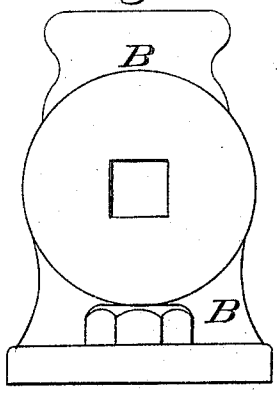


Fig. 2

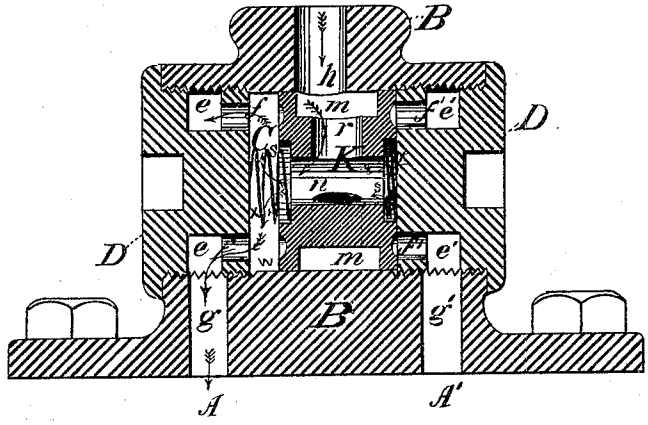


Fig. 3

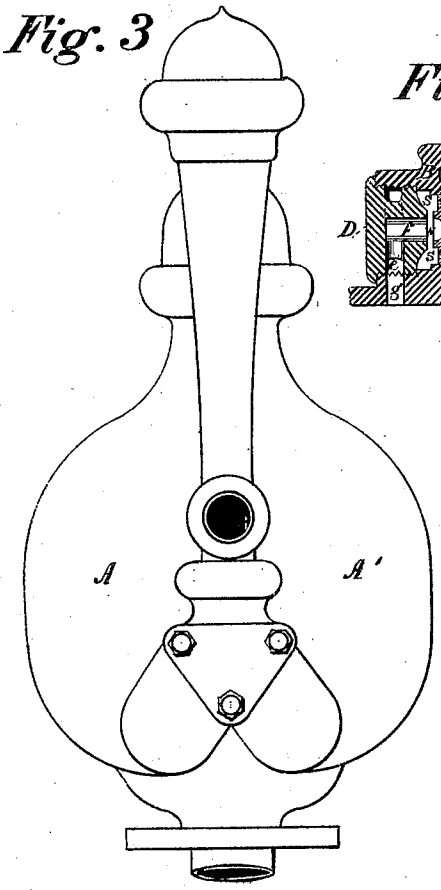


Fig. 5

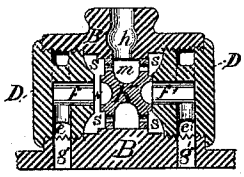
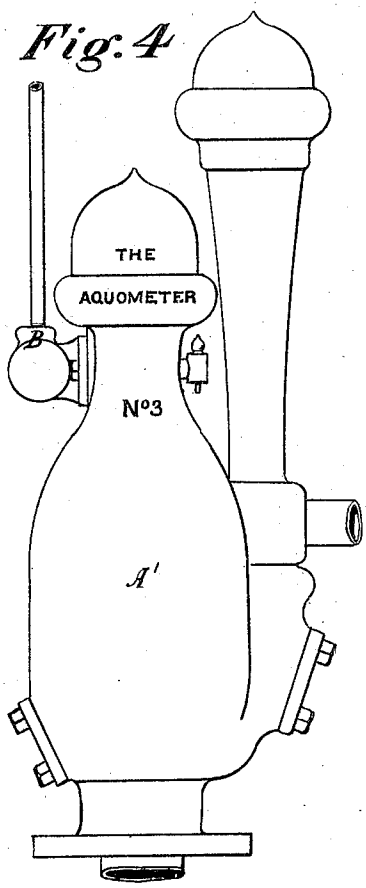


Fig. 4



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UNITED STATES PATENT OFFICE.

WILLIAM E. PRALL AND DAVID A. BURR, OF WASHINGTON, D. C.

IMPROVEMENT IN STEAM VACUUM-PUMPS.

Specification forming part of Letters Patent No. **172,654**, dated January 25, 1876; application filed November 21, 1873.

CASE B.

To all whom it may concern:

Be it known that we, WILLIAM E. PRALL and DAVID A. BURR, of Washington city, in the District of Columbia, have invented certain Improvements in Steam Vacuum-Pumps, of which the following is a specification:

Our invention involves an improvement upon the original invention of William E. Prall, described in his Letters Patent dated December 19, 1871, and reissued November 5, 1872, No. 5,138, in which the admission of steam to a double-acting steam vacuum-pump is automatically controlled by means of a diaphragm, movable piece, or piston, so placed in a channel of communication between the working chambers or cylinders of the pump as to be moved by the reduction of pressure produced within either of them by reason of the sudden vent of the steam through, and its partial condensation within, the discharge-port of the cylinders; and it consists in so constructing the said piston or movable piece controlling the admission of steam to the pump as that a portion of its surface exposed to the pressure of the steam passing through it shall be opposed to a corresponding fixed surface exterior thereto, in such manner as that the reaction or recoil of the steam against such fixed exterior surface shall tend to move the piston or movable piece away therefrom toward the open port to close the same, and shall operate to produce such a movement so soon as a reduction of pressure takes place, as aforesaid, in that chamber of the pump with which said port communicates.

In the accompanying drawings, Figure 1 is an end view, and Fig. 2 a vertical central longitudinal section, of our improved piston-valve; Fig. 3, a front elevation, and Fig. 4 a side view, of our improved "aquameter," or steam-pump, operated by said valve. Fig. 5 illustrates a modification of the valve.

B is a metallic shell or casing, through which communication is established between the working chambers A A′, Fig. 3, of our improved steam-pump when properly attached or connected thereto. (See Fig. 4.) C is a cylindrical chamber, formed longitudinally within the casing B, and which is closed at either end by plugs D D, screwing therein. (See Fig. 2.) These plugs are extended sufficiently within the casing to admit of the formation of an annular groove or channel, *e e′*, about the same, free communication being established between said channel in each plug and the chamber C by means of perforations *f f′* through the inner face of the plug, and outwardly through the casing by means of apertures or eduction-ports *g g′*, arranged to be in register with said annular grooves *e e′* when the plugs are screwed into place, as shown in Fig. 2.

By securing the casing B upon the steam-pump A A′, Figs. 3 and 4, so that the apertures *g g′* shall communicate, respectively, with the two chambers thereof, a channel of communication is thereby established between said chambers through the apertures *g g′*, grooves *e e′*, and cylindrical chamber C.

An aperture or steam-induction port, *h*, is also formed centrally in the perimeter of the chamber C, and suitably re-enforced to receive a pipe connecting from the boiler or steam-generator.

K is a piston or movable piece, fitted to play freely within the cylindrical chamber C, and which operates to close the channel of communication established, as aforesaid, between the chambers of the pump through the chamber C. This piston is so proportioned in length as that, when either end thereof is against the corresponding end of the chamber C, its opposite end shall project beyond the steam-induction port *h*, so that said port is at all times covered by the perimeter of the piston, and yet leave an open space, *w*, beyond and between it and the end of the chamber, as shown in Fig. 2. *m* is an annular groove cut circumferentially about the piston, of such width as that it shall communicate freely with the steam-port *h* when the movement of the piston K is completed in either direction, and of such depth as that its transverse area shall at least equal that of said steam-port. *n*, Fig. 2, is an aperture pierced longitudinally centrally through the axis of the piston, of a diameter somewhat less than that of the steam-port *h*, and which communicates with the annular groove *m* by means of radial holes *r*.

A continuous communication is thus maintained, whatever may be the position of the piston K, between the steam-port *h* and the interior of the chamber C through the central opening *n* in said piston.

The two faces of the piston are made to fit and bear so closely against the inner ends of the plugs D D, respectively, when in contact therewith, as to close by such contact the central opening in the piston K and the perforations *f f'* in the plug. Hence, when either end of the piston is in contact with the inner end of the chamber C, all communication is thereby closed between the steam-port *h* (through the piston and the interior of the chamber C) and the eduction-port *g'* at that end of the casing, free communication being in the meantime established from said steam-port *h* with the opposite eduction-port *g* through the aperture in the piston, the space W, in the end of the chamber C, and the openings in the plug D, as illustrated by the arrows in Fig. 2.

S S are recesses so formed in each end of the piston K, about the central aperture therein, as that when either end of the piston is closed by contact with the inner face of the corresponding plug D, the steam may pass into said recess between the face of the piston and the face of the plug, as shown in Fig. 2. That portion of the surface of the piston included in said recess S is thus opposed to a corresponding surface of the plug exterior thereto, when the end of the piston is in contact with said plug, and the steam passing through the piston passes readily into said recess to react or recoil between said surfaces. This tendency of the steam reacting against the fixed surface of the plug upon the surface of the piston opposed thereto in the recess S, and operating to force the piston away from its seat against said plug, exerts a constant force in that direction proportioned to the pressure of the steam within the piston, so long as the steam finds vent through it.

X X are springs, which may be employed either as an auxiliary to the reactive steam-pressure developed in the recesses S S, as described, or in the stead of, and as a substitute for, the same. These springs, when used, may be placed and secured in recesses formed in the faces of the piston K, as shown in Fig. 2, or in the counterpart faces of the plugs D D, forming the ends of the chamber C, so as to be compressed when the face of the piston comes into contact with the face of the plug or end of the chamber.

It is evident that, instead of carrying the steamway from the annular recess *m* to a central passage, *n*, in the piston, to communicate with steamways formed near the outer edge or circumference of the plugs forming the ends of the chamber C, as illustrated in Fig. 2, perforations may be made through the rim of the said annular recess *m*, to communicate with steamways formed in the center of the plugs, as shown in Fig. 5, the recess S in this last case being made of an annular form on each face of the piston K, instead of centrally thereon.

In the working of our pump and the operation of our said piston-valve K, the reactive force of the steam within the recess S, (or the resilient power of the spring X in the stead thereof,) tending to force the piston from its seat, and to open consequently the steamway closed thereby, is counterbalanced—while the steam is operating to discharge the water from the opposite cylinder A—not only by the superior pressure within said cylinder, (and consequently within the space W in the chamber C, acting against the entire face of the piston at that end to force it toward the passages at the opposite end, communicating with the cylinder A′ of lesser pressure, so that it shall close them,) but also to a greater or less extent by the recoil of the steam issuing in a jet from the open end of the piston. So soon, however, as the pressure in the discharging-cylinder A is reduced by the sudden vent of steam therefrom, as hereinbefore set forth, to a degree less than that in the opposite closed cylinder A′, the constant reactive or resilient power of the steam, or of the confined spring X, or of the two combined, as the case may be, unites with the superior pressure upon the same side of the piston through the channels *g'*, *e'*, and *f'*, to throw the piston against the opposite end of the chamber, and thereby close the ports into the exhausted cylinder A and open those communicating with the cylinder A′, whereupon the same condition is at once established upon that side as previously existed on the other.

We claim as our invention—

In combination with a grooved and perforated piston or valve, K, controlling the admission of steam to a steam and vacuum pump, a recess or steam-space, S, formed within or opposite to the outer face of each end of said valve, to communicate through said valve with the steam-supply pipe of the pump, substantially as and for the purpose herein set forth.

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DAVID A. BURR.

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