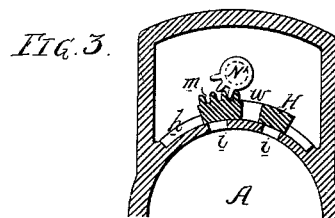
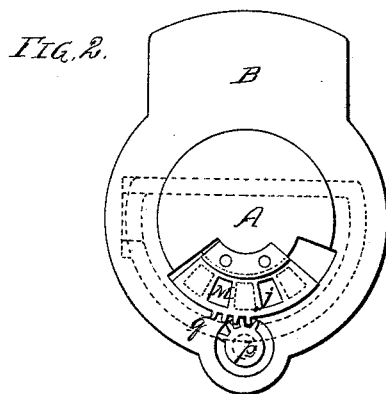
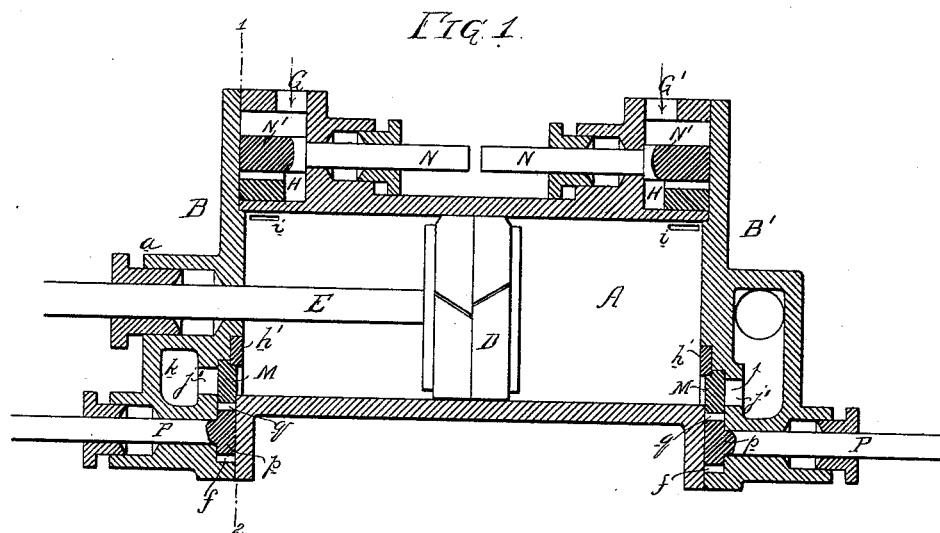


J. B. WARING.
Valves for Air-Expansion and other Cylinders.
No. 218,093. Patented July 29, 1879.



Witnesses
Henry Howson Jr.
Harry Smith

Inventor
John B. Waring
by his Attorneys
Howson & Son

UNITED STATES PATENT OFFICE.

JOHN B. WARING, OF NEW YORK, N. Y., ASSIGNOR OF A PART OF HIS RIGHT
TO CHARLES L. CHASE AND FRANCIS WINTERS, JR., OF SAME PLACE.

IMPROVEMENT IN VALVES FOR AIR-EXPANSION AND OTHER CYLINDERS.

Specification forming part of Letters Patent No. **218,093**, dated July 29, 1879; application filed
January 2, 1879.

To all whom it may concern:

Be it known that I, JOHN B. WARING, of the city, county, and State of New York, have invented a new and useful Improvement in Valves for Air-Expansion and other Cylinders, of which the following is a specification.

My invention relates more especially to that class of cylinders which are used in connection with ice-making and refrigerating apparatus, and in which air, compressed and cooled while under pressure, is permitted to expand to an extent determined by a piston caused to reciprocate in the said cylinder, the air, which has been further cooled by expansion, being subsequently exhausted from the cylinder into a refrigerating or ice-making chamber.

The main object of my improvements in a cylinder of this class is to so construct the inlet and outlet valves and the inlet and outlet ports and passages that the latter cannot be choked with the ice resulting from the freezing of the water contained in the air as the latter enters and escapes from the cylinder.

In the accompanying drawings, Figure 1 is a longitudinal section of an air-expanding cylinder, showing the valves, ports, and passages; Fig. 2, a view of the inner face of one of the covers detached from the cylinder, and showing the exhaust-valve; and Fig. 3, a transverse section on the line 1 2, showing the inlet-valve and passage.

A is the cylinder. B and B' are the two cylinder-covers; D, the piston, and E the piston-rod, passing through the usual stuffing-box *a* on the cover B.

The piston-rod is operated by a crank on the main shaft of an ordinary steam-engine; or it may be reciprocated by a direct-action steam-engine, or by any other motive power.

G and G' are the two inlet-valve chests, one at each end of the cylinder, and both in communication with the air-compressor.

Each inlet-valve consists of a segmental plate, H, Fig. 3, adapted to a segmental recessed seat, *h*, which is concentric with the bore of the cylinder, and as near to the same as is consistent with appropriate strength of metal between the valve-face and inner surface of the cylinder. Hence the air from the chest has but two short ports to traverse before it

gains access to the cylinder—that is, through the ports *w* in a comparatively thin valve-plate, and the ports *i i* in the thin metal intervening between the seat and the cylinder. These passages are too short and direct to afford a lodgment for the ice and snow resulting from the freezing of the water carried by the compressed air.

It may be remarked here that ice and snow are not apt to accumulate within the cylinders of air-expanders, but in the inlet and outlet passages communicating with the said cylinders, and that if these passages are long or slightly indirect or tortuous they are liable to be so choked as to interfere with the proper and efficient working of the machine.

By placing the inlet-valves directly at the points where the air has to enter the cylinder, and by making both the valves and valve-seats segmental, so as to reduce to a minimum the thickness of metal between the valve-seat and inner surface of the cylinder, the shortest passages are obtained.

Each of the cylinder-covers B B' has an exhaust-valve, M, consisting of a plate contained in a recess, *f*, formed in the inner face of the cover, the valve being confined to its seat at the bottom of the recess partly by the flange of the cylinder itself, and partly by a plate, *h'*, let into and secured to the cover.

The ports *j* in the valve and the ports *j'*, communicating with the outlet-chamber *k*, are so short that the above remarks concerning the non-accumulation of snow and ice in inlet-ports will apply with as much force to the outlet-ports.

All the valves are operated through the medium of pinions on the valve-spindles and segmental racks on the valve. Thus the spindle N of each inlet-valve has a pinion, N', gearing into the teeth of the rack *m* on the segmental valve H, Fig. 3, while each valve-spindle P has a pinion, *p*, gearing into the teeth of a segmental rack, *q*, on the outlet or exhaust valve, the valve-spindles themselves being vibrated from the driving-engine through the medium of any suitable valve-motion.

I do not desire to claim, broadly, the combination of a segmental valve and segmental seat; but

I claim as my invention—

1. The combination of the segmental valve H, adapted to a segmental recessed seat, and having a rack at the back, with a spindle, N, having teeth adapted to the rack, all as set forth.

2. The combination of the inlet-valve, adapted to a recess in the cylinder-cover, with the flange of the cylinder and the plate *h'*, which

together retain the valve in place, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

J. B. WARING.

Witnesses:

WM. J. COOPER,
HARRY SMITH.