

J. A. WARDEN.

Device for Feeding Air to Furnaces.

No. 204,926.

Patented June 18, 1878.

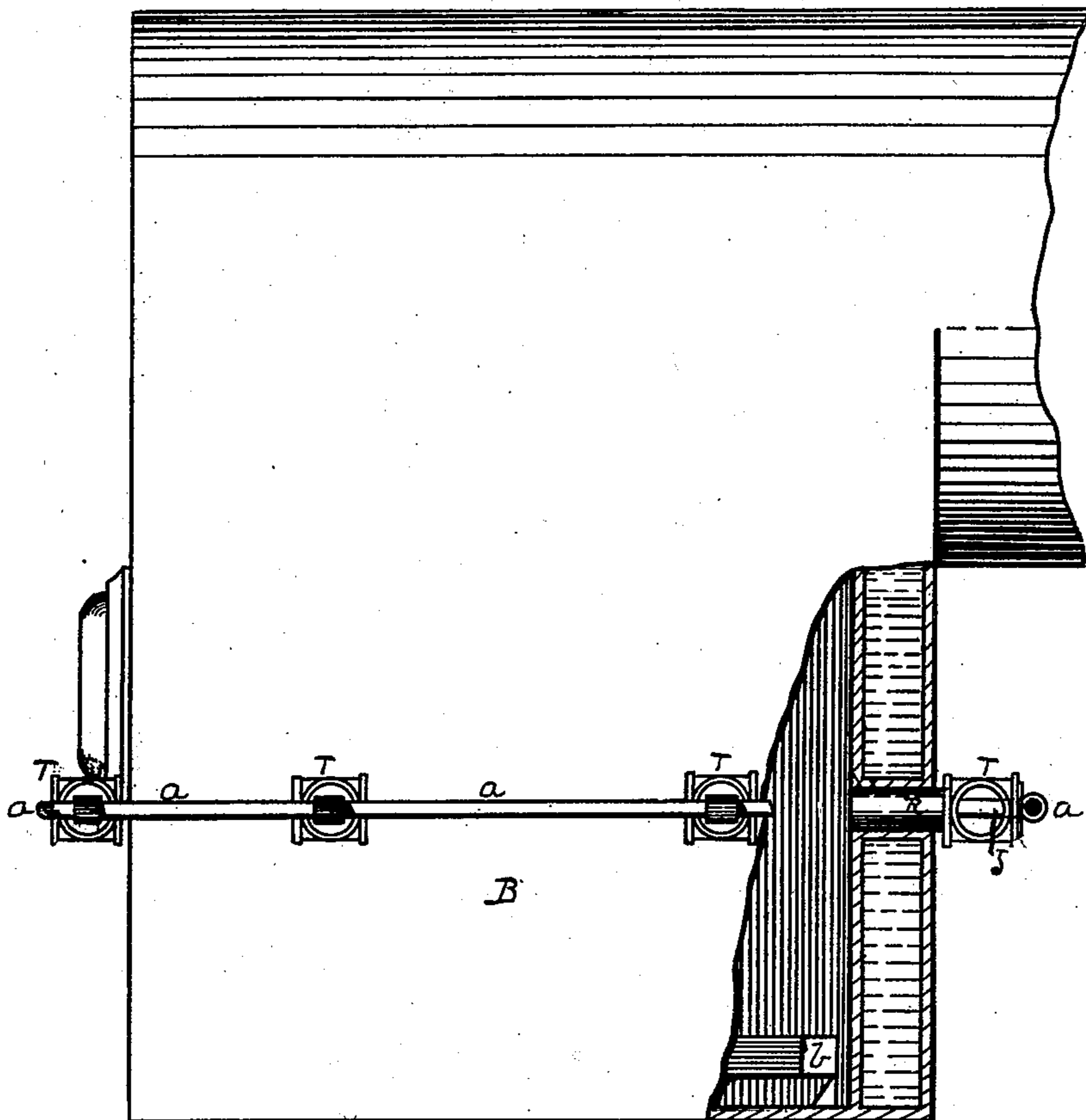


Fig. 2.

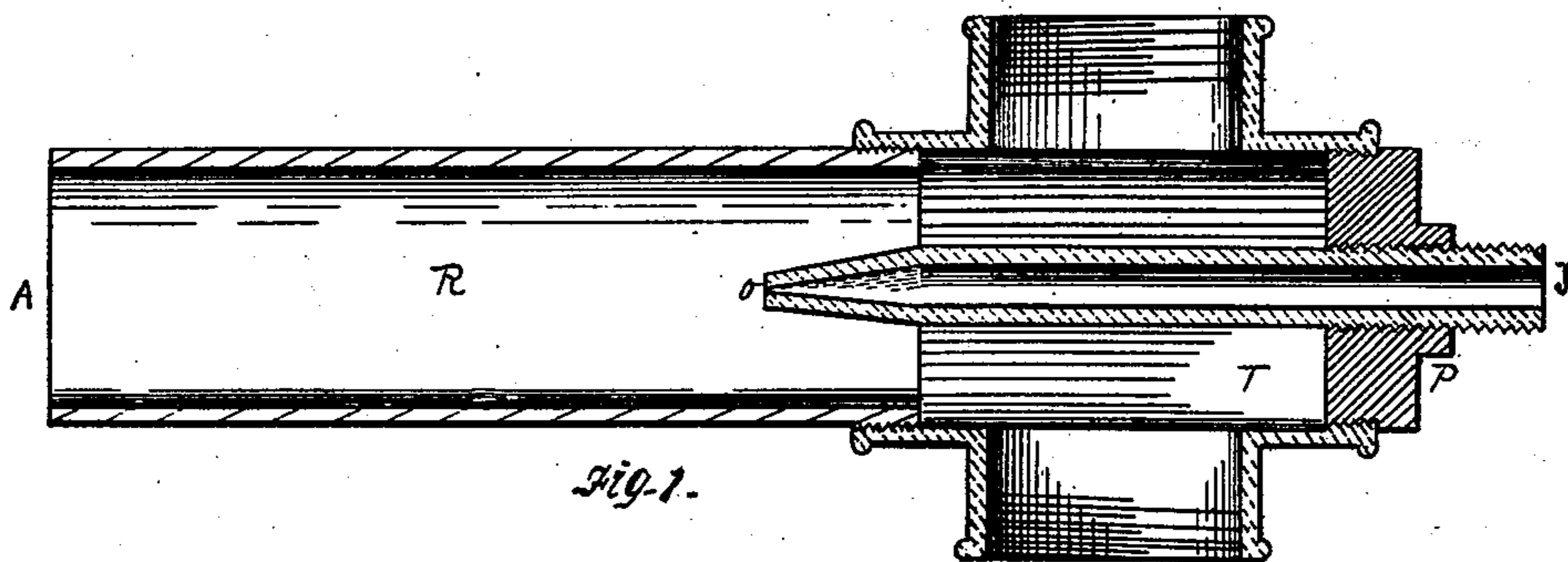


Fig. 1.

Witnesses.

*M. S. Connolly*  
*C. L. Parker*

Inventor.

*John A. Warden*  
*by George H. Christy*  
*his Atty.*

# UNITED STATES PATENT OFFICE.

JOHN A. WARDEN, OF SEWICKLEY, PENNSYLVANIA.

## IMPROVEMENT IN DEVICES FOR FEEDING AIR TO FURNACES.

Specification forming part of Letters Patent No. **204,926**, dated June 18, 1878; application filed March 21, 1878.

*To all whom it may concern:*

Be it known that I, JOHN A. WARDEN, of Sewickley, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful Improvement in Smoke-Burning Attachment for Furnaces; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawing, making a part of this specification, in which—like letters indicating like parts—

Figure 1 is a sectional view of the steam-nozzle and air-pipes illustrative of my improvement, and Fig. 2 illustrates the manner of applying the same to the furnace or fire-box of a locomotive-engine.

My invention relates to an improvement in devices for supplying atmospheric air, whether hot or cold, to the combustion-chamber of a furnace or other fire, and particularly to that form of blower through which air is injected by the medium of a jet of live steam.

Heretofore such blowers have been constructed of varying forms, but usually with such a preponderancy of steam-supply as to, in a great measure, destroy their general usefulness.

The general form of all such blowers is that of a larger outer air-tube surrounding a smaller steam-pipe, the steam-pipe receiving dry steam at some point upon the exterior of the air-tube, and exhausting it at some point within and back of the air-tube outlet, the air-tube being open at its outer end for the reception of free air, which is drawn in by the action of the steam-jet, and forced out, mingled with the steam, at the air-tube outlet within the furnace.

The results heretofore attained by the use of such blowers have not been as beneficial, generally, as was anticipated, and in fact, I believe, have proven to be practical failures.

By a somewhat extensive series of tests and experiments I have found that such failure has resulted, in part, at least, from an improper proportioning and relative arrangement of the steam-jet and air-pipe with reference to each other and to the boiler-pressure. In some cases the steam-jet orifice is placed so near the air-exit as to pass the steam into the furnace without any, or with but little, air; or it may be placed so far in the rear as to prevent, by its expansion in volume, the introduction of air in

useful proportions. Also, if the steam-jet orifice be too large or too small, relatively to the size of the air-passages, too much or too little air will be introduced, and under such conditions as to lessen instead of promote combustion. The velocity of the steam is also a modifying element.

To obviate these difficulties, and to construct an injector which shall be practically operative in promoting combustion by securing the admixture of steam and air in proper proportions, and supply it to the furnace in economic quantities, and at the same time be capable of general application, is the object of my invention.

In the drawing, B represents an ordinary locomotive fire-box. The pipe R, leading therein at any desired distance above the grate-bars *b*, but preferably a little above the level of the fuel, is the air-inflow passage. As shown in the drawing, it is fitted with the four-way fitting T, and the base aperture is closed by a plug, P, through the center of which passes the steam-jet pipe J, having a jet-opening at *o*.

I construct my blower with the outer pipe R of any desired diameter, according to the work to be done, and I place within it the steam-jet J, and so proportion the discharge-openings of each that under the boiler-pressure employed from five to ten cubic feet of steam will be injected, and will inject about one hundred cubic feet of air, the numbers "five" and "ten" representing about the minimum and maximum proportions of steam for each one hundred of air. These proportions will be secured by making the diameter of the steam-jet orifice from one-fortieth to one sixty-sixth that of the air-outlet, and the mouth or exit *o* of the steam-jet must be adjusted to a point about two hundred times its diameter to the rear of the air-outlet A, or about three times the diameter of the latter.

By adopting in the area of the openings the approximate proportions mentioned, I obtain in the air-passage the greatest volume of air capable of being carried at effective speed by the velocity due to a steam-jet at ordinary locomotive-boiler pressures with the least volume of steam capable of effective work at all pressures, and by placing my jet at a point equal to two hundred times its diameter in the rear of the air-outlet, I utilize all its effective

force and expansion, and eject my blast thoroughly mingled and at a point when all the effective power of the steam as an injecting medium is exhausted. Steam ejected from a free opening under ordinary locomotive-boiler pressure reaches its effective expansion-point at a distance about equal to two hundred times the diameter of the opening through which it escapes, and at that point its force or pressure is spent.

I do not confine myself to the form of device shown. Any approved form may be adopted, and constructed approximately upon the relative proportions as to areas and distances, as hereinbefore specified.

Having thus constructed an injector capable of furnishing steam and air in a combination in which the steam does not exceed ten per centum of the entire volume, it becomes a simple matter of detail to provide a furnace with such a number of blowers with a common steam-supply, *a*, as shall furnish to the combustion-chamber not less than one hundred cubic feet of the blast for each pound of coal consumed, and thus obtain an almost or quite perfect combustion.

It is essential to the best results in apparatus of the character herein described that the steam-ejector nozzle be arranged inside the

air-conduit pipe, so that its full propelling force shall be exerted and made effective on a column of air laterally confined. If the ejector be arranged outside and back of the entrance to the air-conduit pipe, the steam will act on a larger column of air than can be passed through the pipe, whereby the air will be partially choked at the entrance, and reactionary air-currents will be established, with a consequent diminution or destruction of useful effect.

I claim herein as my invention—

1. The herein-described injector, constructed with its outlet air-opening of a diameter about fifty times that of the steam-jet opening, and having the latter adjusted inside the air-conduit pipe, and at a point about two hundred times its diameter in rear of the outlet air-opening, substantially as and for the purposes set forth.

2. A series of steam-ejectors, *J*, and air-pipes *R*, proportioned and adjusted as described, in combination with a fire box or chamber, substantially as set forth.

In testimony whereof I have hereunto set my hand.

JOHN A. WARDEN.

Witnesses:

JOHN BURKE,

GEORGE H. CHRISTY.