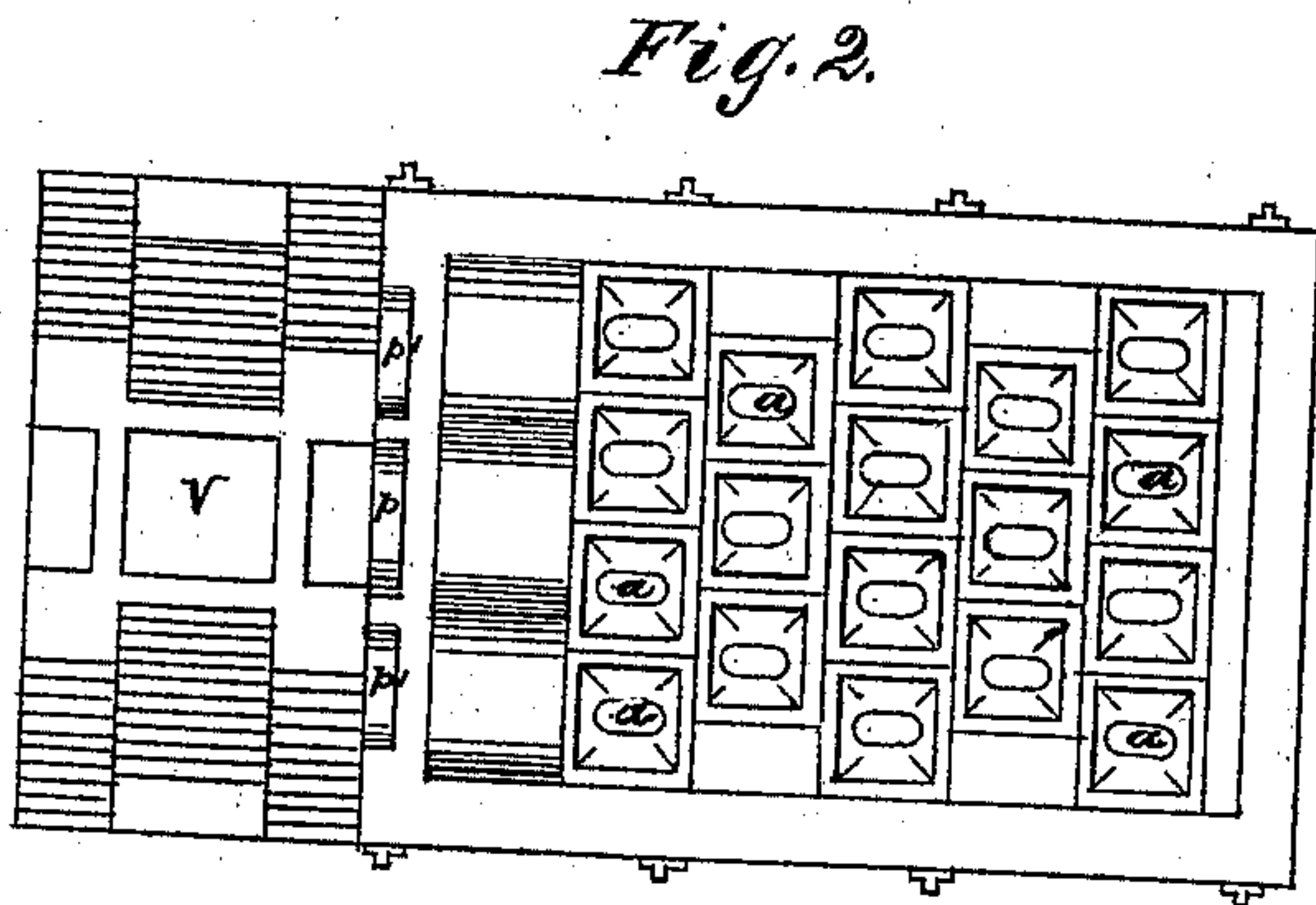
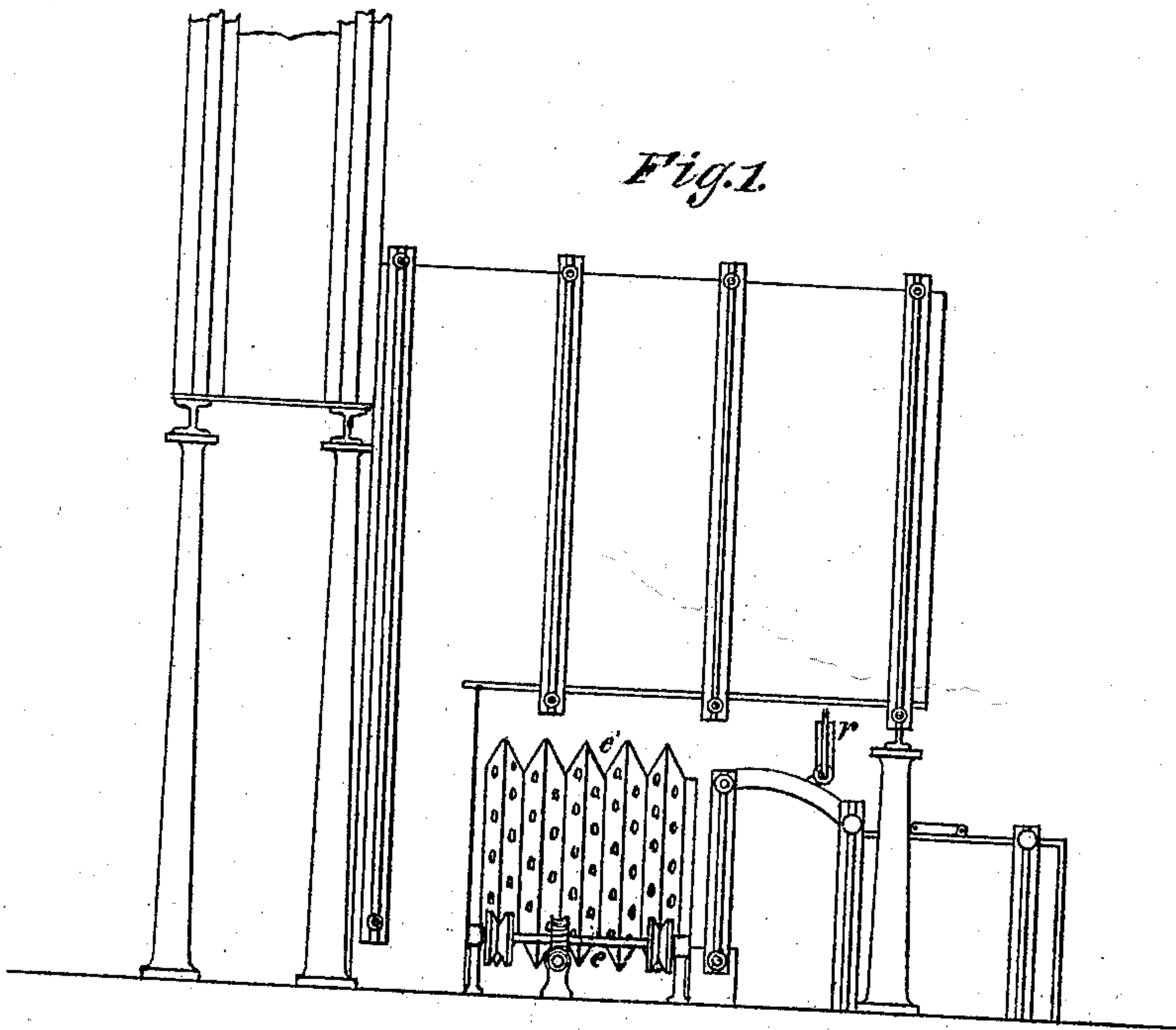


3 Sheets--Sheet 1.

G. E. HARDING.
Furnaces for the Manufacture of Iron and Steel.
 No. 143,145.
 Patented September 23, 1873.



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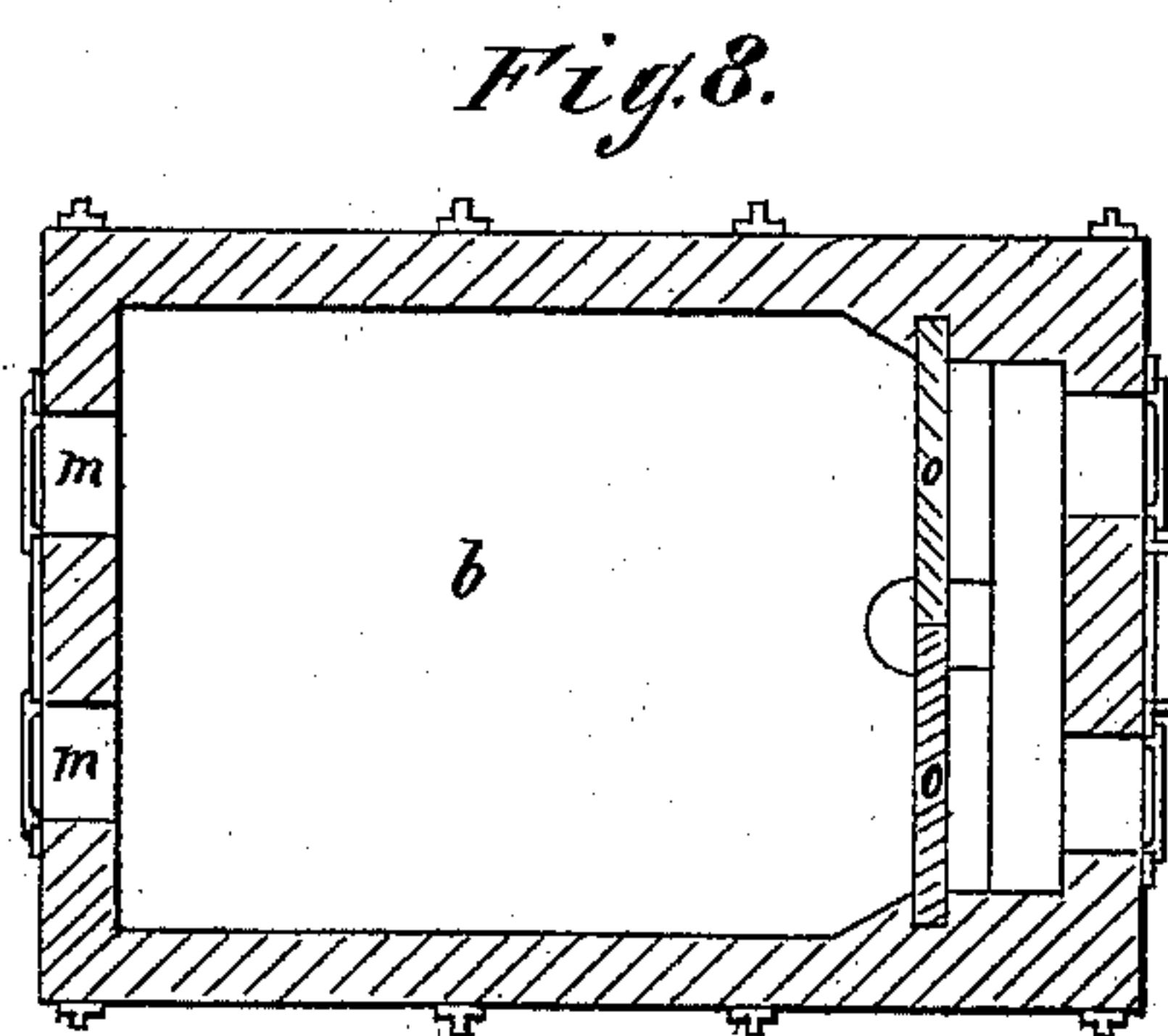
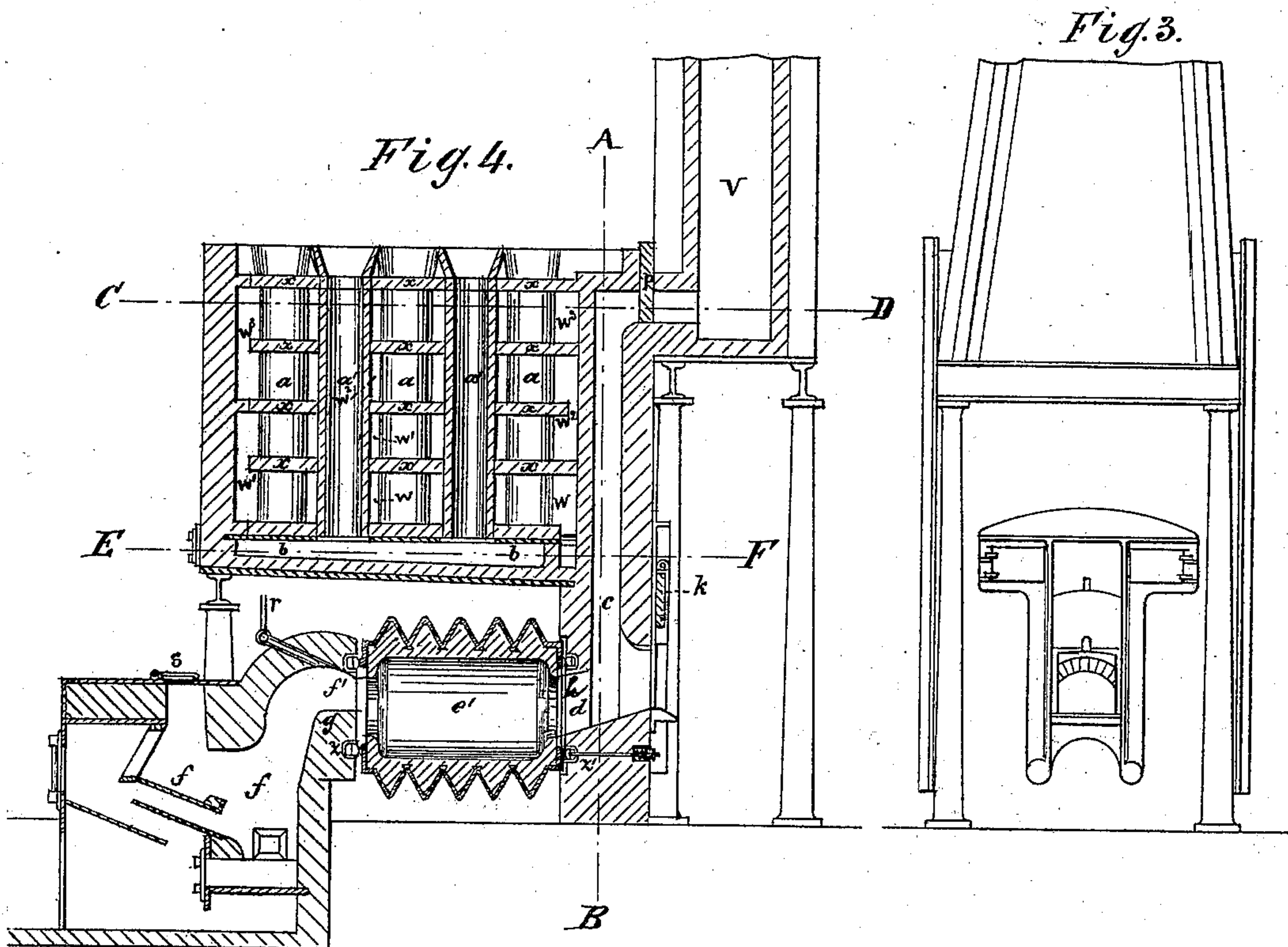
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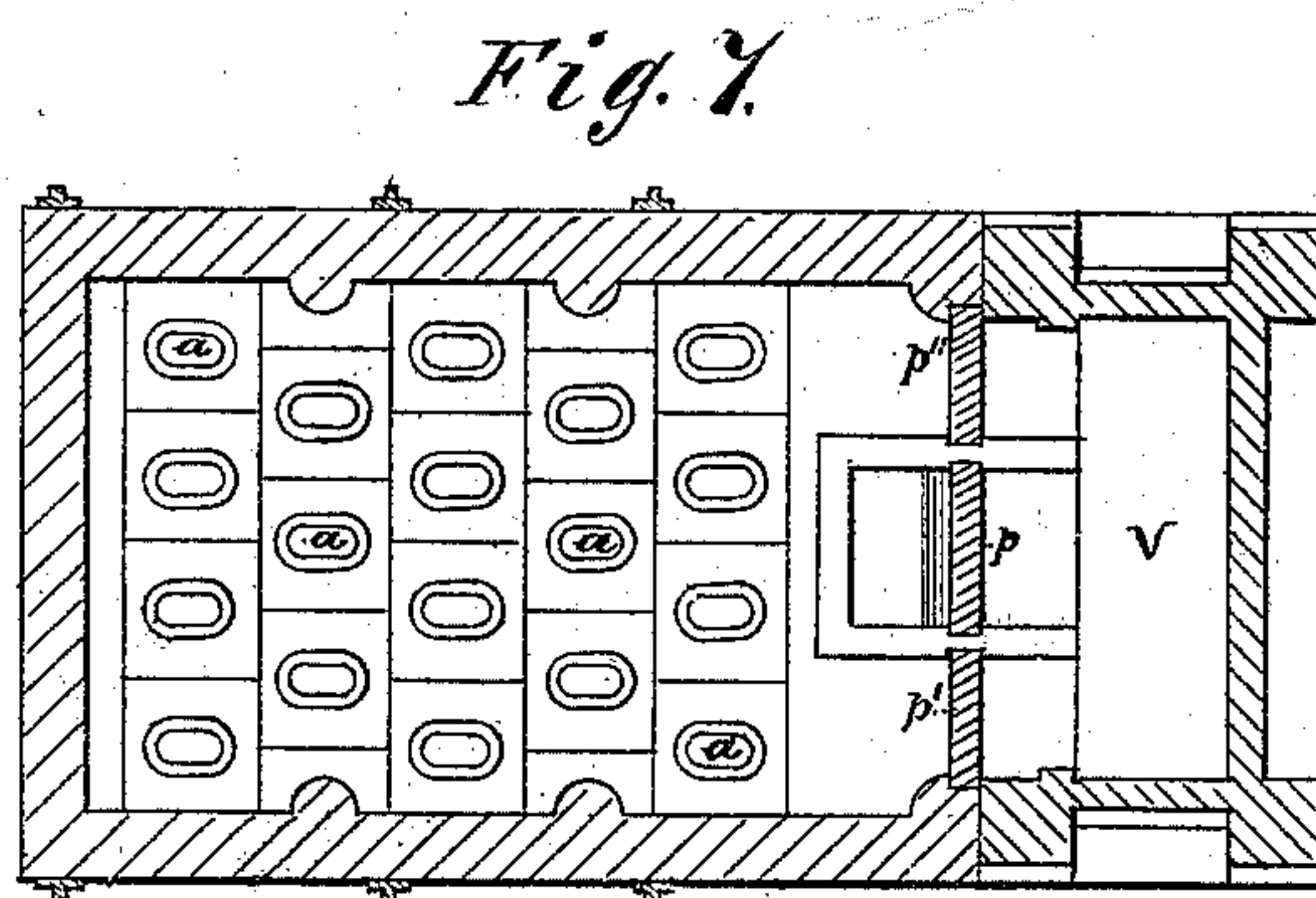
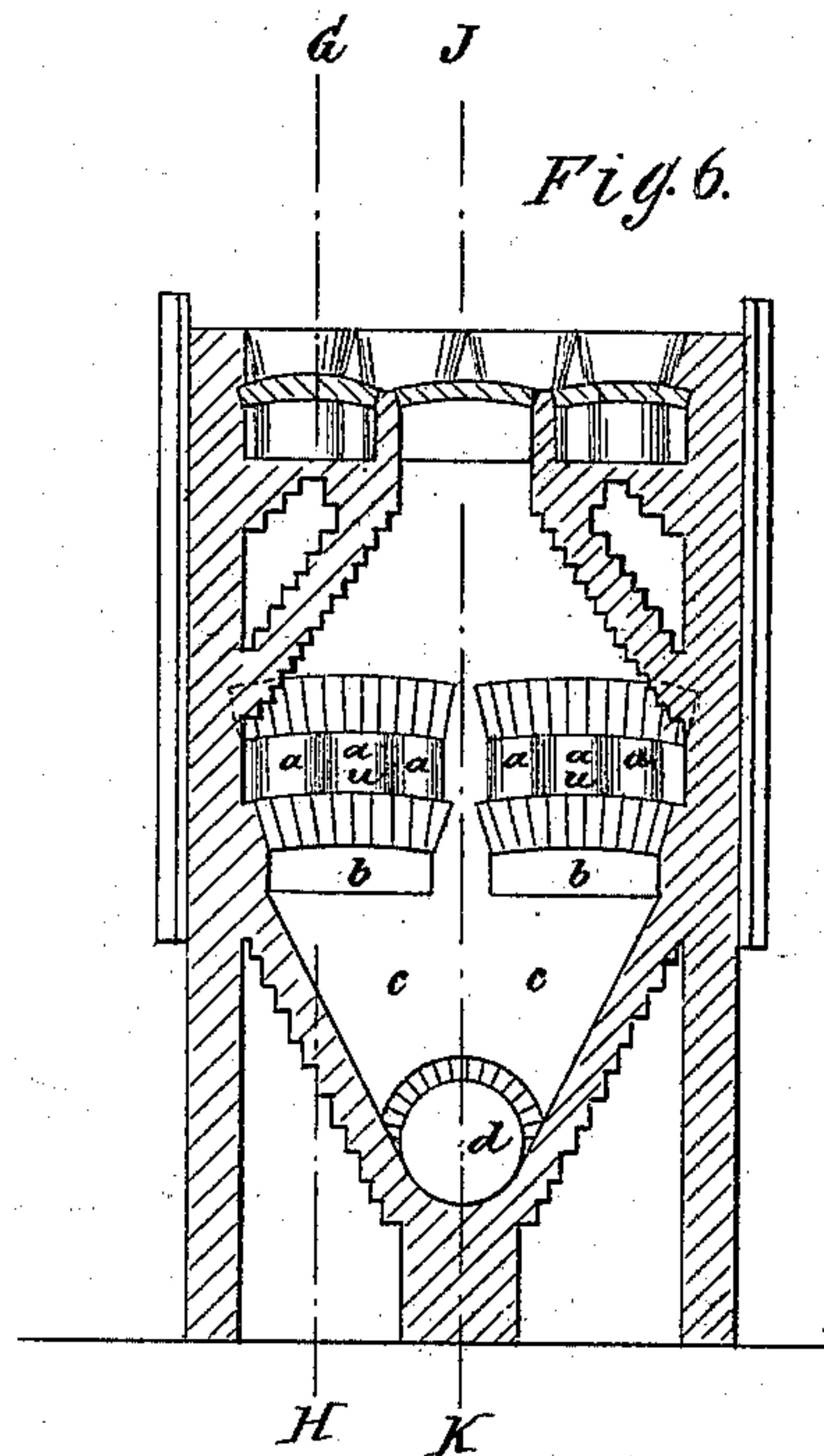
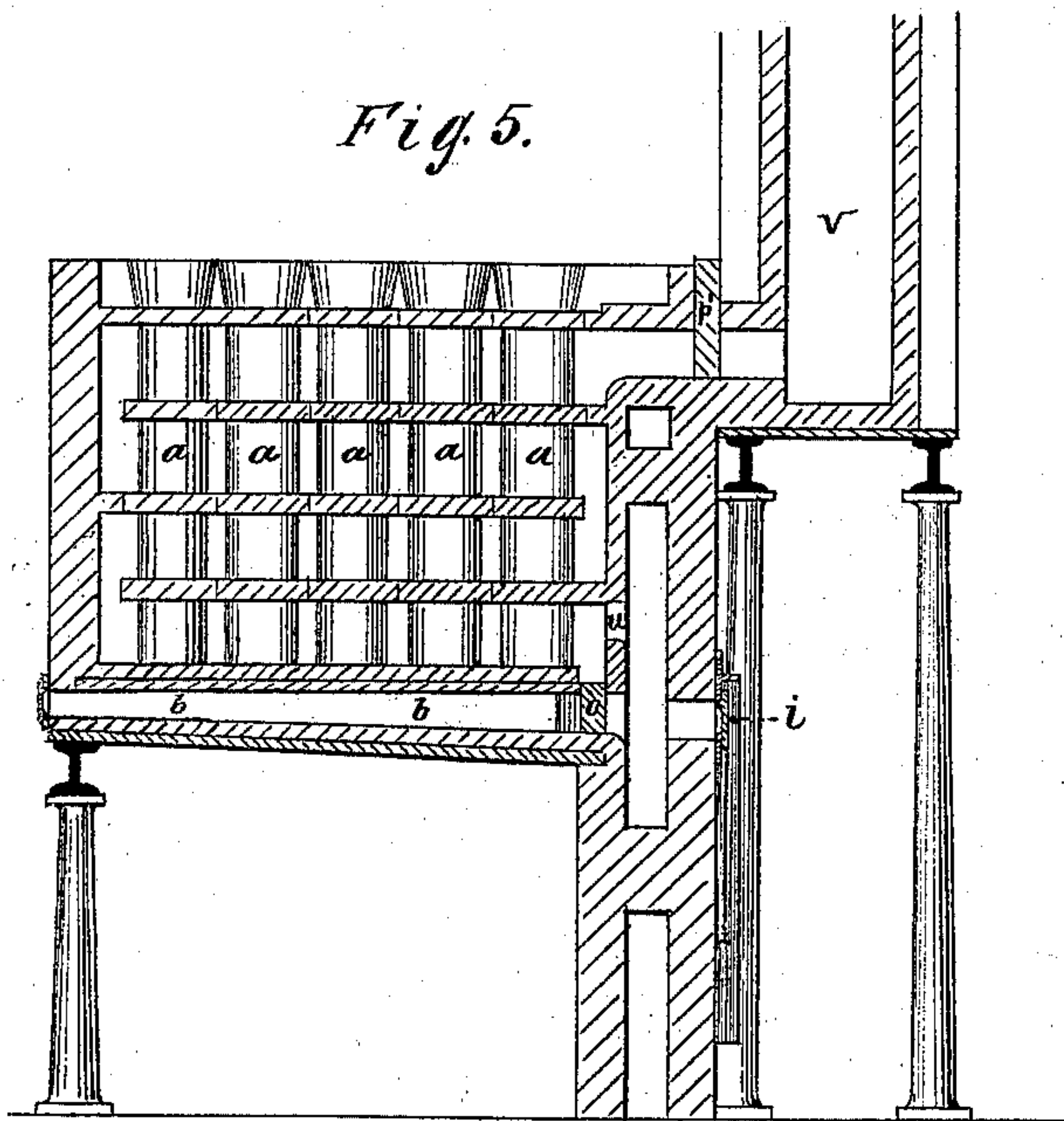


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UNITED STATES PATENT OFFICE.

GEORGE E. HARDING, OF NEW YORK, N. Y.

IMPROVEMENT IN FURNACES FOR THE MANUFACTURE OF IRON AND STEEL.

Specification forming part of Letters Patent No. **143,145**, dated September 23, 1873; application filed May 28, 1873.

To all whom it may concern:

Be it known that I, GEORGE E. HARDING, of the city, county, and State of New York, have invented a new and Improved Furnace for Producing Wrought-Iron from the Ore Direct, of which the following is a specification:

In the accompanying drawings, Figure 1 represents side elevation. Fig. 2 represents plan elevation. Fig. 3 represents front elevation. Fig. 4 represents longitudinal section at I K. Fig. 5 represents longitudinal section at G H. Fig. 6 represents transverse section at A B. Fig. 7 represents horizontal section at C D. Fig. 8 represents horizontal section at E F.

Similar letters indicate corresponding parts.

The improvement consists in the application of a rotary puddling-furnace for the reduction of iron ores, in combination with a furnace for producing the gases of combustion and a deoxidizing-chamber for utilizing the "waste" gases for deoxidizing and carbonizing the ores previous to their reduction in the rotary by means of retorts or shelves arranged in the chamber to intercept the waste gases on their way to the stack.

In Fig. 4 the apparatus, as preferably adopted, is shown. A large rectangular chamber is connected with the base of the stack by the flues and dampers $p p' p''$, and also with the rotary puddling-hearth e and furnace f by the shaft c . This deoxidizing-chamber can be either provided with the vertical retorts $a a a$ and the horizontal shelves or hearths $x x x$, as shown; or, in certain cases, the retorts can be omitted and shelves alone superposed. The former arrangement is preferable, and the retorts are charged from their top with a mixture of pulverized ores, flux, and carbon. At first the gases from the furnace passing through the rotary are allowed direct vent to the stack by the shaft c and flue p ; then, when well under blast, the damper p is closed and the gases are diverted through u , Fig. 5, backward and forward between the retorts $a a a$, passing through $w w' w'' w'''$ and flues $p' p''$, Fig. 7, into the stack, impinging against the retorts at different elevations and at right angles, thus parting with a very considerable portion of their heat to the retorts and the contained ores. The retorts, preferably of elliptical sec-

tion, discharge their contents into the common receptacle $b b$, which receptacle is provided with the sliding gates $o o$, Fig. 8, and air-tight doors $m m$.

Whenever it is desired to introduce a charge of deoxidized ores in the rotary hearth, the gates $o o$ are raised by connections at their ends, and by opening the doors $i i$ the requisite quantity is raked to the shaft c , whence, by means of the door h , the charge arrives in the rotary without undue exposure to the oxygen of the air. The rotary is then operated by suitable mechanism, undergoing the necessary agitation and puddling, and the ball finally removed by the door h to the hammer or squeezer, when a new charge is similarly brought down. As the ores are removed at the bottom the retorts are recharged at their tops, and by drawing alternately from the different series of retorts the operation becomes continuous.

The divisions or shelves $x x x$ in the arrangement shown perform the double purpose of guiding the gases of combustion and serving to connect the several joints of the retorts, while at the same time, in the event of injury to any section of a retort, that portion can be readily removed and replaced without disturbing any other part of the chamber.

By the proper adjustment of the dampers $p p' p''$, any desired direction and pressure of the burning gases can be obtained, and the deoxidation of the ores as well as the pressure of the gases in the rotary may be under complete control.

The rotary hearth shown beneath the deoxidizing-chamber is of corrugated section of cast or wrought iron, so arranged as to hold the refracting lining and fettling, and also to radiate the heat that reaches the casing as rapidly as possible. To this end holes are also made in the casing, as shown. It is also provided with tapping-hole for drawing off the cinder, and has the rings $z z$ pressed against each end of the rotary hearth by springs and rods to prevent leakage of the gases, which springs are adjustable by nuts at the outer rounds z' . The face of each ring is beveled, allowing any lodged cinder to work out automatically and prevent binding of the rotary.

The furnace shown is similar to the Wilson gas-puddling furnace, but any gas or common

furnace may be used. Immediately above the bridge-walls *g*, however, are introduced the concentric pipes *r*, by which a jet of combined steam and air is injected in such varying proportions as the different stages of the puddling process demand, and which has been already secured to the inventor by Letters Patent, dated July 30, 1872, No. 130,044.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The general arrangement of the furnace *f*, rotary *e*, flue *d*, shaft *c*, chamber *w' w'' w'''*, retorts *a a a*, and dampers *p p' p''*, as shown and described.

2. The rings *z*, with beveled faces and adjustable tension-springs *z'*, for the purpose specified, as shown and described.

GEO. ED. HARDING.

Witnesses:

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