

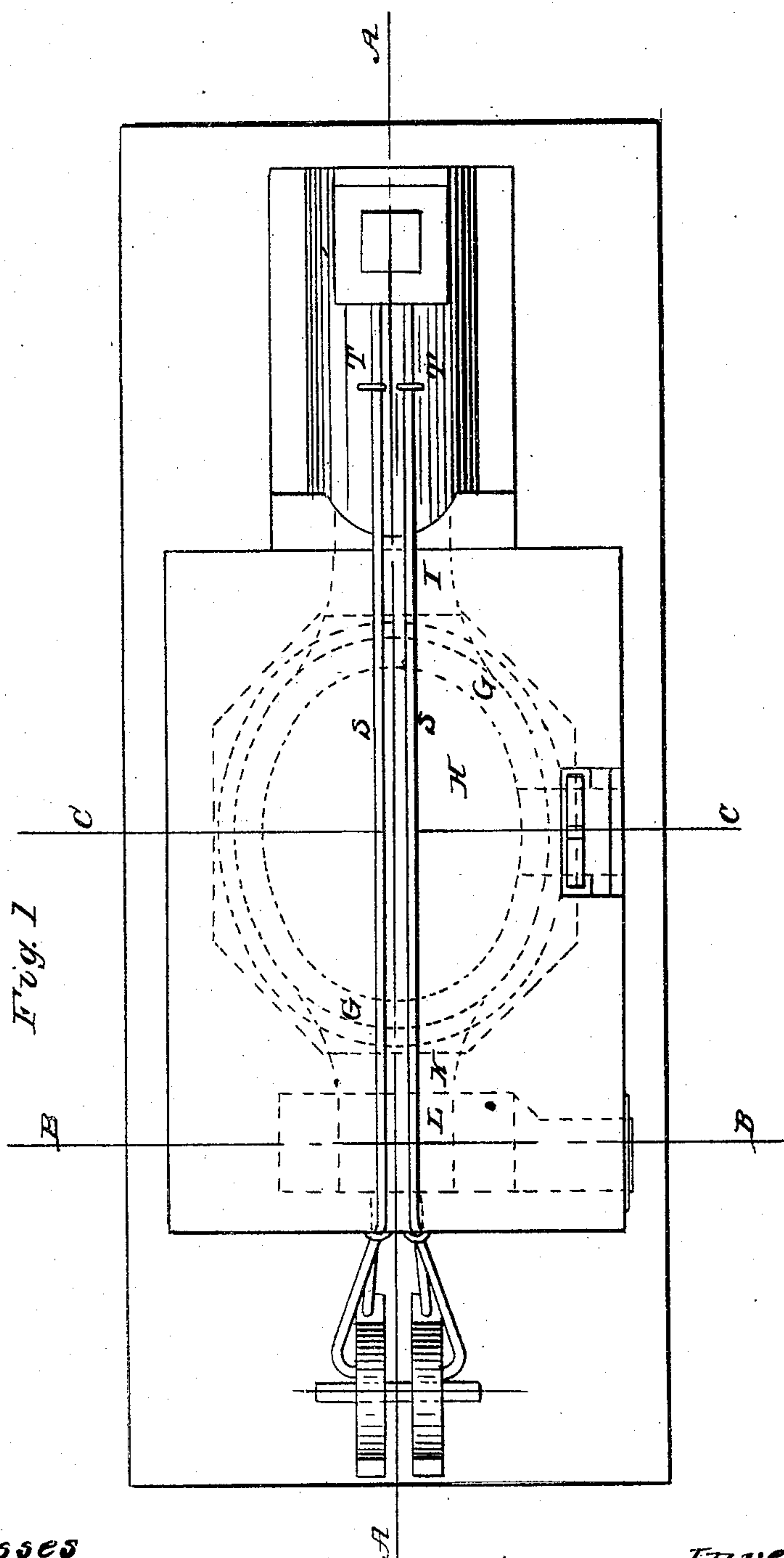
WHELPLEY & STORER.

Making Iron.

5 Sheets—Sheet 1.

No. 101,067.

Patented March 22, 1870.



witnesses
Chas. H. Peterson
Edw. W. Longley.

Inventors
James D. Whelpley
Lucas L. Storer.

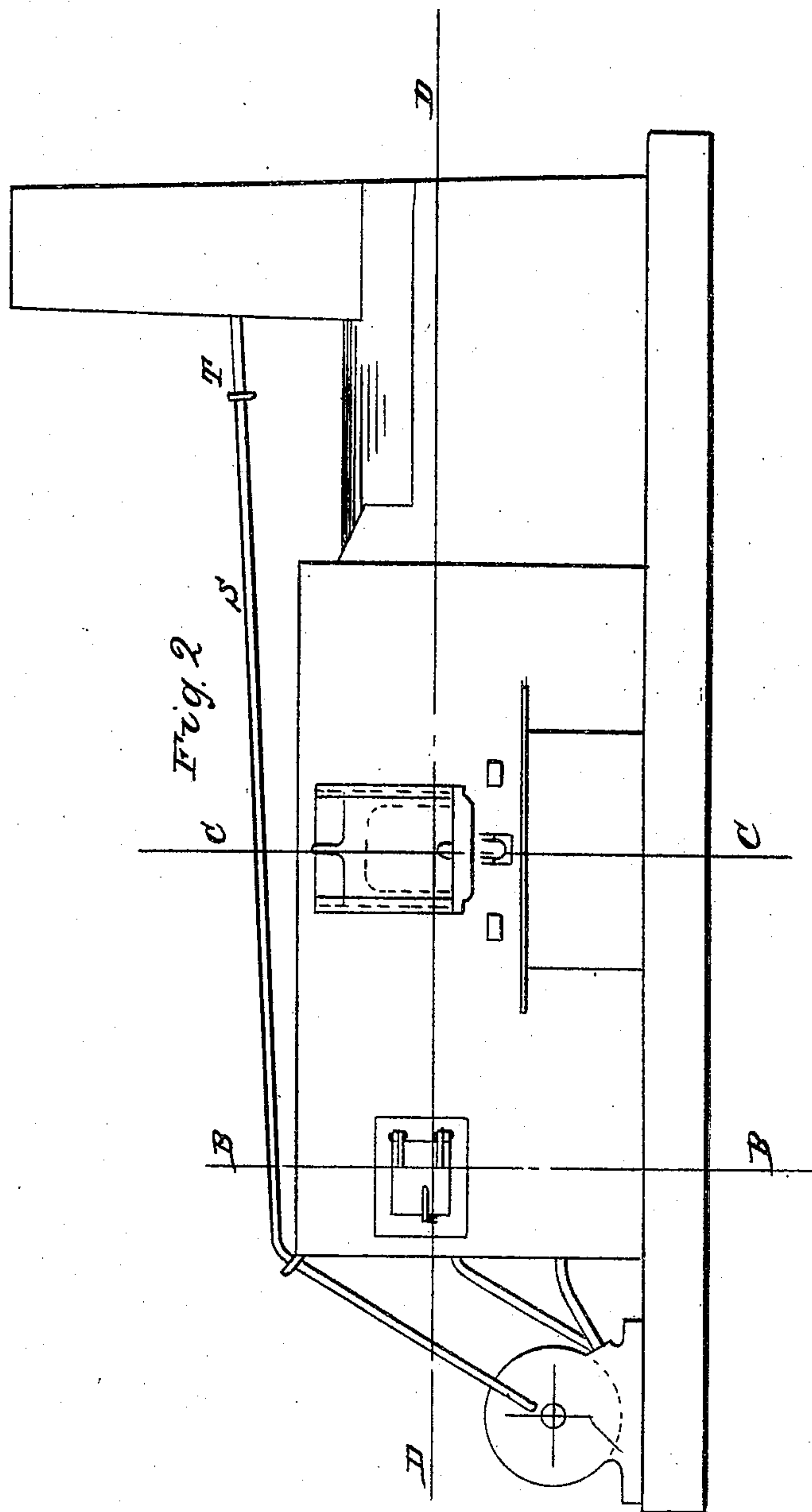
WHELPLEY & STORER.

5 Sheets—Sheet 2.

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Witnesses
Chas. H. Jackson
Fred W. Longley

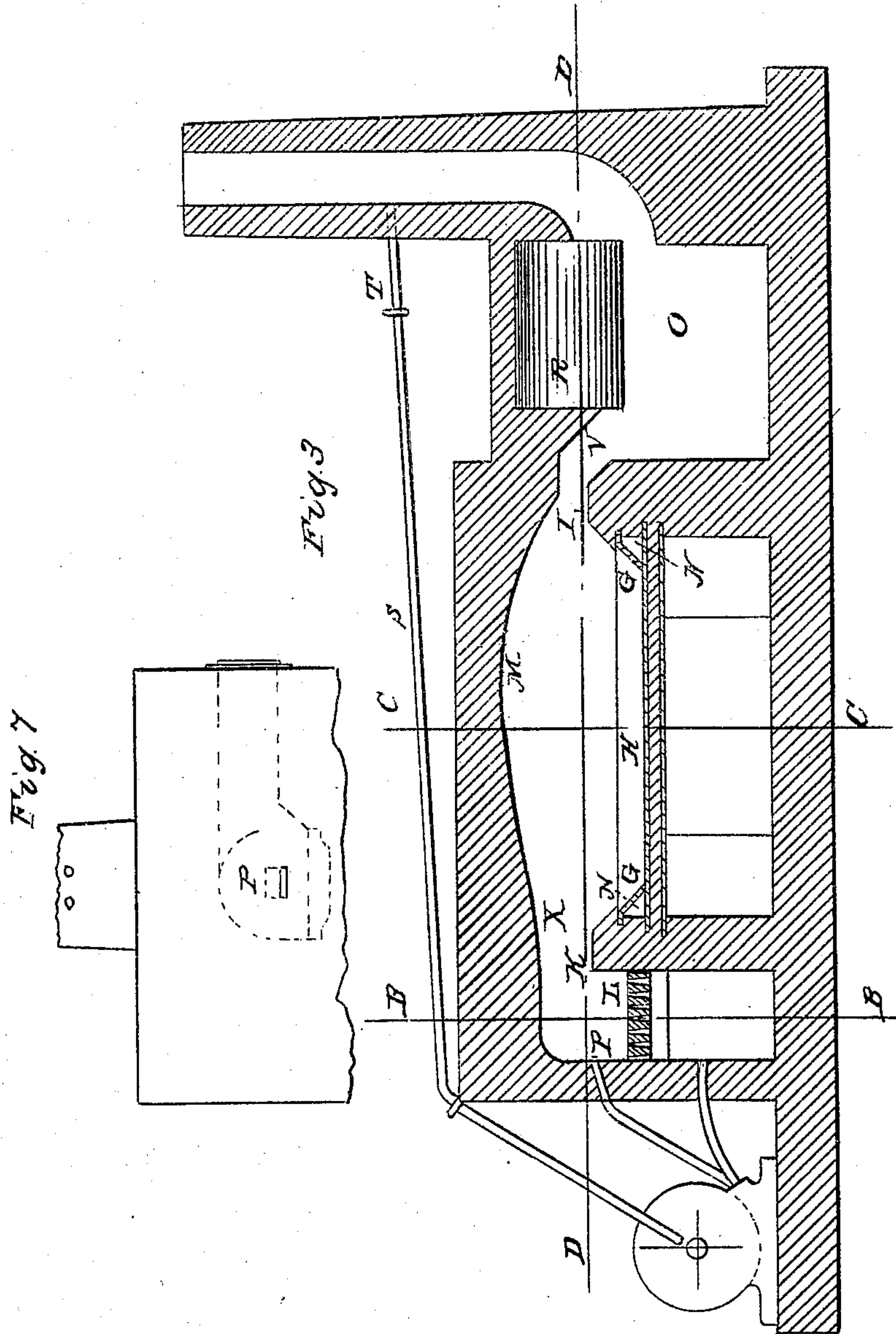
Inventors
James J. Welpley
Laurd V. Storer

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Fred W. Longley.

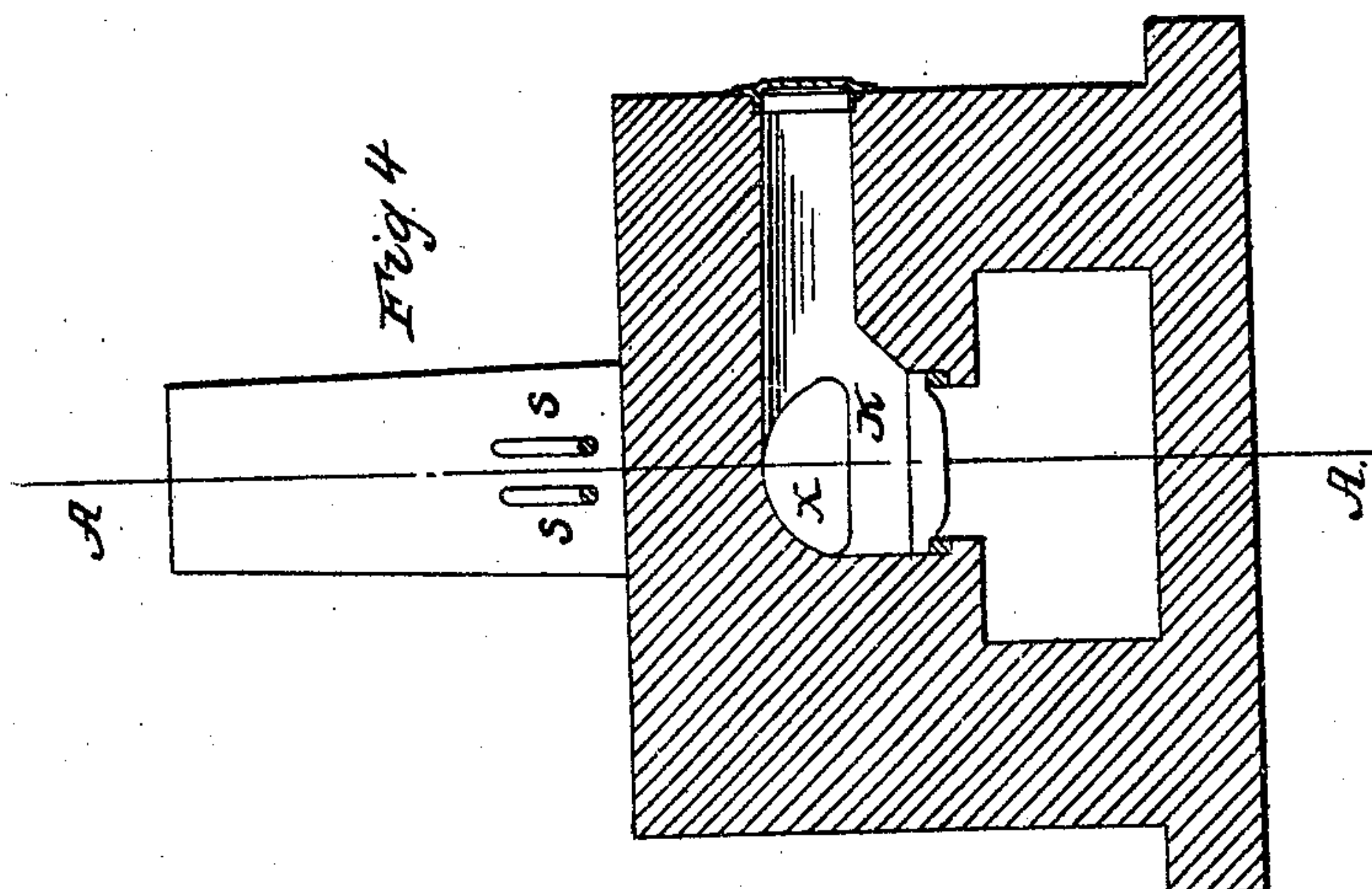
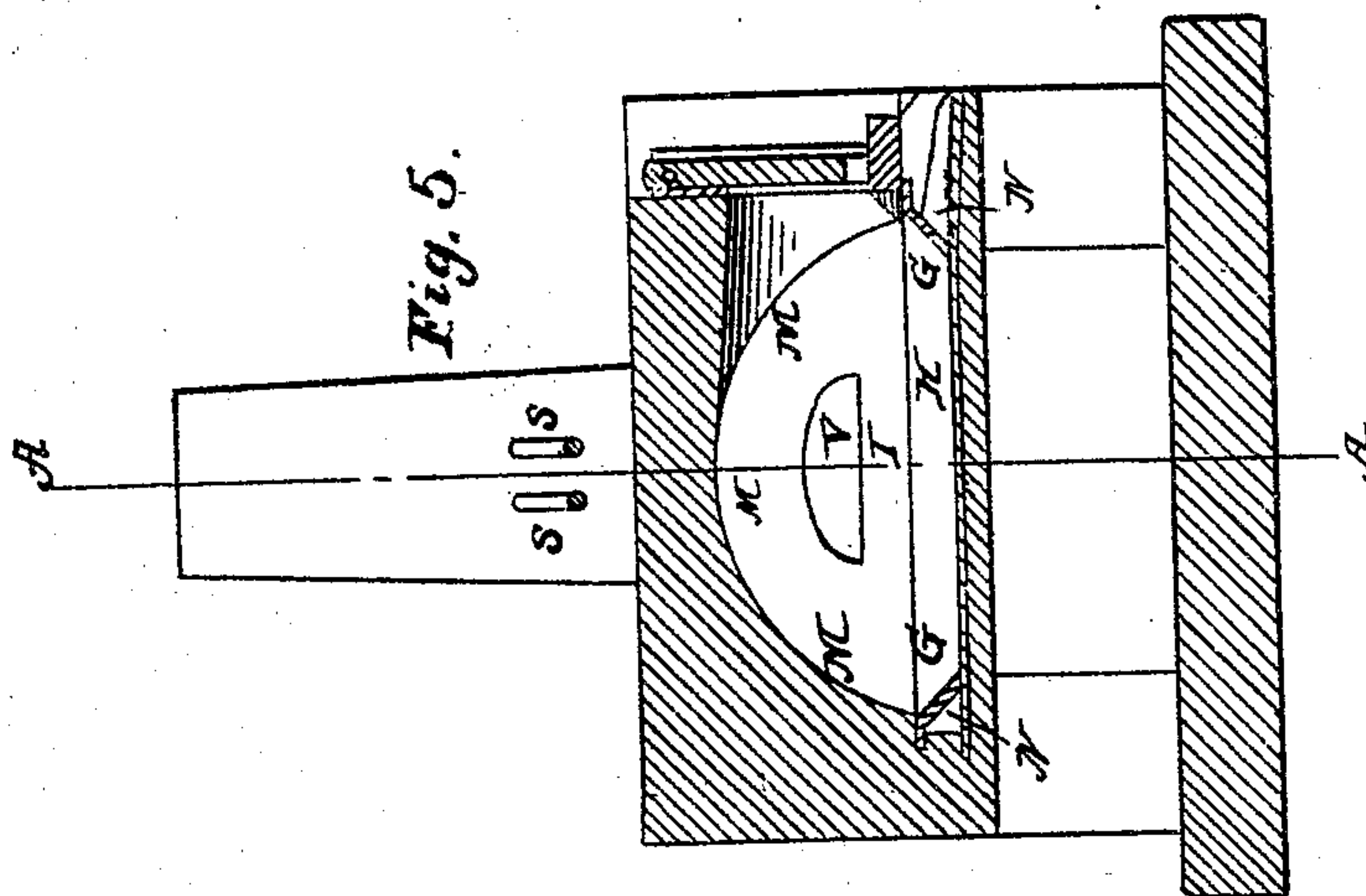
James D. Welpley
Levi L. Storer.

WHELPLEY & STORER.

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witnesses
Chas. MacKintosh.
Fred W. Goughley.

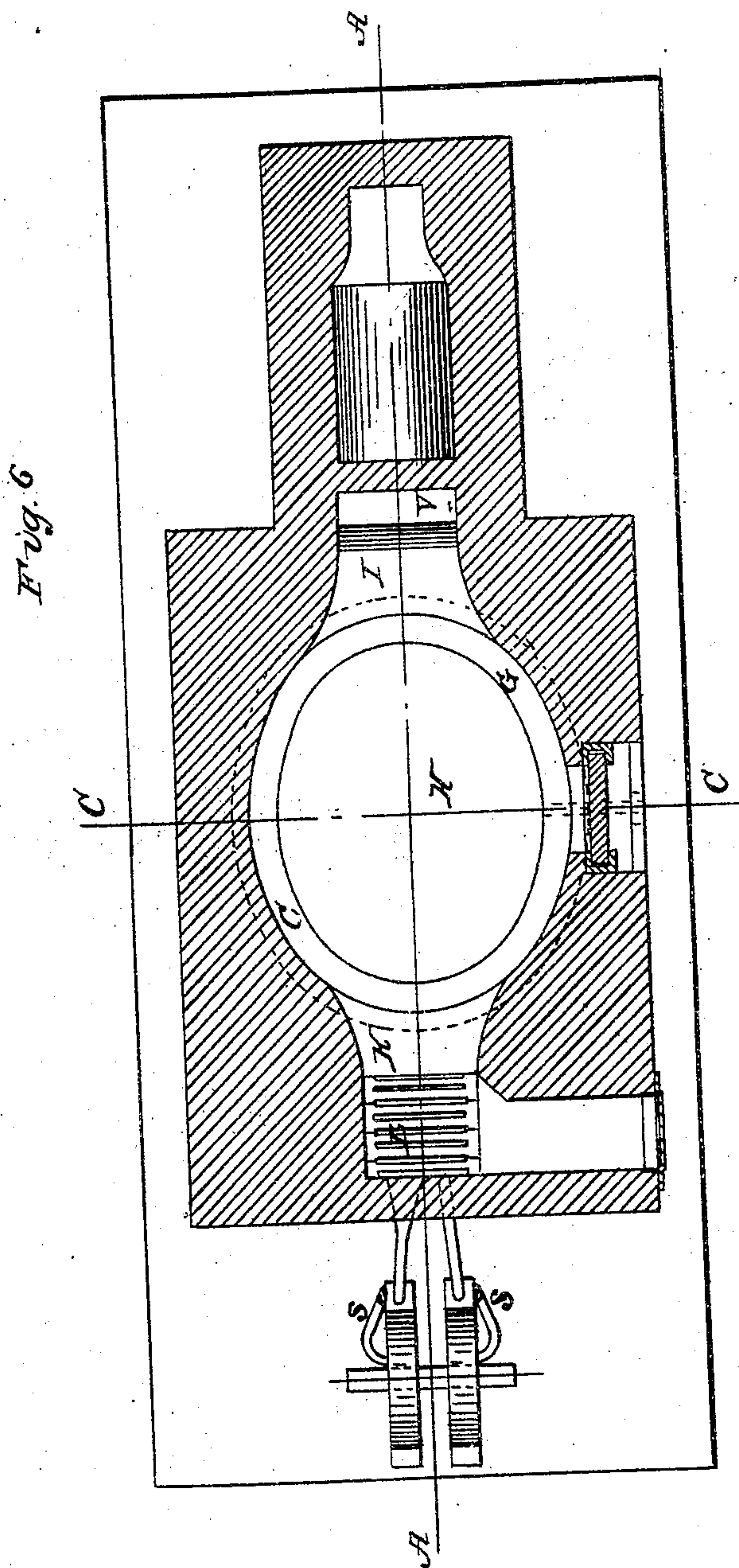
Inventors
James D. Welpley
David L. Storer

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witnesses
Chas. H. Hickerson.
And W. Langley

Inventors
James D. Whelpley
David L. Storer

United States Patent Office.

JAMES DAVENPORT WHELPLEY AND JACOB JONES STORER, OF BOSTON,
MASSACHUSETTS.

Letters Patent No. 101,067, dated March 22, 1870.

IMPROVEMENT IN THE MANUFACTURE OF IRON AND IN THE APPARATUS THEREFOR.

The Schedule referred to in these Letters Patent and making part of the same

To all to whom these presents shall come :

Be it known that we, JAMES DAVENPORT WHELPLEY and JACOB JONES STORER, both of Boston, in the State of Massachusetts, have invented an Improvement in the Manufacture of Iron and the Apparatus therefor, which the following specifications and accompanying drawing sufficiently explain.

The nature of the improvements in the apparatus and process consist in forming the interior lines of a reverberatory furnace used for the heating, melting, or puddling of iron, or the manufacture of iron directly from the ore, by the use and application of pulverized fuel through the mechanism invented and employed by us, in curves, so that the shape of the body or working part shall as nearly as possible approximate to the semi-concave of an ellipsoid or prolate spheroid, divided lengthwise by a horizontal plane, which represents the hearth.

Description of the Accompanying Drawings.

Figure 1 is a plan.

Figure 2 is a side elevation.

Figure 3 is a longitudinal vertical section on line A

A.

Figure 4 is a transverse vertical section on line B B.

Figure 5 is a transverse vertical section on line C C.

Figure 6 is a horizontal section on line D D.

Figure 7 is an end elevation, showing feed-pipe entrance.

Toward the fire-place L the sides and roof are contracted, so as to form a pear-shaped neck, X, concluding at the back wall of the fire-place. This neck is, in transverse section, but from one-fourth to one-fifth, more or less, of the largest transverse section of the body of the furnace.

From two to four square feet of grate-surface is found to be sufficient for a furnace from eight to eighteen feet in interior length, and proportional width.

The hearth or sole of the furnace H will be constructed in adaptation to the work which is to be done upon it. If iron or steel or other metals are simply to be heated or melted, then of fire-sand or brick or other refractory material. If cast-iron is to be puddled or boiled, then of cinder or ore, as is customary in other furnaces used for such purpose.

The bottom plate is of cast-iron, on which rest the cast-iron boshes G, surrounded by air-channels N, in the usual manner. We prefer the sloping and curved boshes, as shown in the drawing, as being, in our judgment, best adapted to this form of furnace; but we do not insist upon this slope, for boshes with perpendicular face will not be objectionable.

The kind and quantity of work to be done in the furnace will determine, as in other furnaces, the heights of the fire-bridge and flue-bridge.

The small horizontally-elongated opening P in the back wall of the fire-place, about midway between the grate-bars and the roof, is for the introduction into the furnace of the pulverized fuel which is projected on a blast of air.

A comparison of the usual puddling, heating, or roasting-furnace, in which lump or massive fuel alone is burned, with a furnace of the same working capacity of our design, will show that in the usual style of furnace the grate-surface is from ten to fifteen square feet or more, or in the proportion of four or five to one of the grate-surface employed by us, and the fire-place proportionally deep, thus indicating great consumption of fuel and excessive supply of air, and consequent formation of large columns of gas; that, in order to give sufficient room for these gases and products of combustion to escape, the sides of the furnace are built up perpendicularly, and the roof is a flattened arch, so that deep angles giving more room may result; that not only must much heat be wasted in these angles, but a large proportion must be useless for work, because the lines of heat radiation from the side walls do not fall upon the hearth.

In this furnace, designed by us for the use of pulverized fuel, lump coal, to the depth of about three inches only, is fed through the door upon the grate-bars in the usual manner in puddling-furnaces, which, when well ignited, sufficiently heats the surrounding walls of the fire-place. In a furnace of this kind, with from two and a half to three square feet of grate-surface, the lump coal consumed on the grate-bars, say from twenty to thirty pounds per hour, is simply to heat the fire-box wherein the jet of pulverized fuel is ignited, and does not serve in any considerable degree to heat the body of the furnace, whereas in a furnace of the usual kind, of the same capacity, from four hundred to five hundred pounds of lump coal, with which all the work of heating is accomplished, are required in the same time.

As soon as the walls of the fire-place L become sufficiently heated, the pulverized fuel is projected on a jet or blast of air through the opening P, and over the fire-bridge K, into the focus of heat, as described in our patents of March 13, 1866, and March 31, 1868, and is instantly ignited by the heat radiated from the fuel on the grate and from the curved walls and roof of the fire-place, and carried along on the blast, burns in the body of the furnace under the roof.

The apparatus which we employ for comminuting the fuel and introducing it into the furnace consists

of the pulverizer which has already been secured to us by patents No. 36,580, September 30, 1862; No. 44,990, November 8, 1864; No. 48,226, June 13, 1865; No. 49,187, August 1, 1865; No. 50,975, November 14, 1865; No. 59,693, November 13, 1866; and of our apparatus for the delivering grain, ores, &c., into grinding or pulverizing-mills, for which we have made application for a patent of the United States.

It is a possible and practical thing to introduce the fuel previously pulverized by a fan-blower, but we prefer the apparatus which simultaneously pulverizes and delivers the fuel in quantities that can be easily and accurately regulated by simple mechanical devices, thus giving to the process of stoking or fuel feed an automatic character, governed by machinery.

The use and application of pulverized fuel as an auxiliary in the heating of a furnace or the working of iron has been indicated in the English patents of Dawes, in 1832; of Banks, in 1840; of Desboissierres, in 1846; of Mouchel, in 1854; of Mushet, in 1857; of Slate, in 1858, and perhaps by some others; but we use and apply it as the prime agent for heating and working in the furnace, which they do not do, nor in the manner nor by the apparatus designed by us.

Some of the advantages of using pulverized fuel in the manner designed by us have been set forth in our patents above referred to, and the advantages claimed by us in using the form of furnace above described for the application of pulverized fuel, for the purposes herein indicated, are as follows:

The comparative smallness of the grate-surface determines the use of a much less quantity of massive or lump fuel than in the usual furnace of equal capacity for work.

The form of the roof and sides M M is especially adapted to the combustion of finely-pulverized coal and gases, being the best for allowing a full and rapid expansion of the gaseous products of combustion, and serving to focus the heat upon the column or jet of pulverized coal and air, as it floats through the furnace, thus more fully insuring complete combustion, and serving to equalize in the most perfect manner the radiation and reflection of heat from the floating burning fuel upon the hearth.

Because there are no re-entering or projecting angles in the furnace beyond the fire-bridge, it being arched from the boshes upward, there is no escape of heat, except what unavoidably passes out through the vent or flue V, and into and through the brick-work.

It has been fully demonstrated in other furnaces and ovens, that the curves of the roof and sides cause the lines of heat radiation to fall fully and evenly upon the hearth or the work thereon, and for our process they are peculiarly adapted, for the reason that they permit the almost complete escape of the floating ashes of the pulverized fuel through the flue V, so that but a minimum amount is deposited upon the work, and cause so thorough a reverberation and even distribution of the flame and gases that the hearth or work thereon can at will be evenly covered or enveloped with a carbonizing, neutral, or oxidizing flame, in direct contact with almost equal heat in every part.

The blast under the grate-bars is furnished by a fan-blower, or other apparatus, from any convenient point. We always prefer the artificial or force blast under the grate-bars to the natural or exhaust blast.

In several competitive trials with pulverized coal made between the usual form of puddling and heating-furnaces, and the form herein described and shown in the drawings, it has been found:

First. That in the form described in the accompanying drawings, the economy of coal is nearly fifty per centum over the other.

Second. That in this furnace and with this process, the usual loss of iron in puddling or heating in being

oxidized or burned is reduced sixty to eighty per centum.

Third. That this form of furnace is more quickly heated with the same amount of fuel, the gain in time being from fifteen to twenty per centum.

Fourth. That but a very small amount of ashes is deposited upon the hearth of our furnace, while it is heaped up on the sides of the hearth in the angles of the other.

Fifth. That the furnace designed by us for the application of pulverized fuel is heated throughout with almost perfect evenness, while in the other the angles and parts about the flue-bridge are always comparatively cold.

Sixth. That the gases generated by the combustion of the floating particles of burning carbon are more thoroughly than in any other furnace brought down upon the hearth or work, so that oxidation, reduction, or carburization can be obtained at will.

Seventh. The furnace with continuous hollow lines is not more expensive to build, and is, owing to its form, more durable than the other.

Eighth. The curved lines of the hearth make the working and manipulation of the furnace-charge more easy.

When a reducing or carbonizing flame is used in the furnace, a portion of the pulverized fuel will sometimes escape into the smoke-stack and pass up unconsumed in company with the gases. To remedy this loss of fuel, as well as to prevent the excessive escape of heat and unconsumed gases up the stack, we sometimes adopt the device described in "A Practical Treatise on Metallurgy," by Crookes & Röhrig, published in 1869, volume 2, page 585, which is to return the unburned carbon and heated gases passing up the stack through the fire upon the grate, by means of a fan-blower or blast-pipe, or to return them by means of a pipe into the pulverizer, to be mingled and introduced into the furnace with the pulverized fuel.

The two pipes, S S, represented in the drawing, leading from the stack to the pulverizer and fan, for the return of hot air and unconsumed pulverized fuel and gases, are accordingly furnished with slide-doors or valves T T at any convenient point, to regulate their supply.

We do not claim this as a novelty, the same having been done in other furnaces; but we deem the combination of this improvement with our application of pulverized fuel a matter of importance in our process, under certain conditions.

The flue ash-pit O shown in the drawing, and which is placed between the end of the furnace and the smoke-stack, is not only for the deposition of the ashes floated through the furnace on the auxiliary blast, but also is of great advantage in preventing, when using a carbonizing or reducing flame in furnace, the escape of smoke or unconsumed dust-fuel through the stack. In it, (it being of greater area than the stack itself, six feet square, more or less,) there is a retardation of the velocity of the current of gases carrying the ashes and unconsumed fuel on their way to the stack, and an expansion of the moving column; consequently the major part of the ashes is deposited therein, and the unconsumed fuel is sufficiently delayed in its escape toward the stack to become wholly or almost wholly consumed. This combustion of the escaping fuel in the ash-pit is perfectly assured by the admission of air through small convenient orifices in the sides of the pit.

It is an advantage to supply this auxiliary feed of air through the boshes or through channels in the walls of the furnace, so that it may enter heated in some degree, though this device is not essential, and consequently is not represented in the drawing.

It is customary to place a boiler for the utilization of the waste heat of a furnace by the generation of steam, over the stack, which for this purpose is car-

ried off horizontally; but we prefer to place the boiler R over the flue ash-pit between the furnace and stack, as represented in the drawing.

This furnace, constructed as described, and of a suitable size for that purpose, is used by us under or in connection with boilers as an improvement upon the form of fire-box with brick arches and inclined jambs, patented by us in Letters Patent No. 76,280, dated March 31, 1868. In this adaptation and combination, where only the generation of steam is sought for, the furnace with its fire-place will be from one-quarter to one-third the length of the boiler, more or less, the flue-bridge I forming the lip of an ash-pit, as shown in drawing, such as is usually placed under boilers, into which the ashes will be precipitated in the course of combustion.

We consider this an improvement, because we find that the combustion of anthracite culm is more complete in this apparatus than in any other with which we are acquainted.

We claim—

1. A furnace with hollow or continuously-curved interior lines, (without re-entering angles beyond the fire-bridge, except at the working-door,) in combination with our process for burning pulverized fuel, and the apparatus especially adapted by us therefor, as and for the purposes substantially as described.

2. The form of furnace described in the above specification and drawings, in combination with the method of using pulverized fuel, as described in our patents of March 31, 1868, claim four, and for the better economy thereof, substantially as and for the purposes described.

3. The use of the products of combustion or heated air drawn from the flue or air-chambers or stack beyond the furnace and returned with air through the fire, in combination with the process of using pulverized fuel, and the apparatus and furnace, substantially as and for the purposes described.

4. The ash-pit and combustion-chamber beyond the furnace, covered or not covered by a steam-boiler, in combination with the use of pulverized fuel in a furnace with hollow interior lines, substantially as and for the purposes described.

5. The use and application of pulverized fuel in a furnace of the kind above described as the prime agent in heating the furnace and in working the iron, &c., as and for the purpose substantially as described.

6. The comparatively small fire-box and contracted neck of the furnace as the best design for a furnace in which lump or massive fuel is to be used simply for the ignition of the pulverized fuel, the principal part of the heating being done and the character of the flame being determined by the latter, as and for the purpose substantially as described.

7. Burning the fuel wholly or principally in the body of the furnace, not in the fire-place, suspended in air and gases over the work or the hearth, and in this way obtaining better results than are possible by the burning of gases alone in the body of the furnace, or by burning lump or massive fuel in the fire-box.

JAMES D. WHELPLEY.

JACOB J. STORER.

Witnesses:

CHARLES M. NICKERSON,
FRED. W. LONGLEY.