(No Model.) 2 Sheets—Sheet 1.

J. J. WILLIAMS.

SMELTING FURNACE.

No. 409,541. Patented Aug. 20, 1889.

Fig. 1.

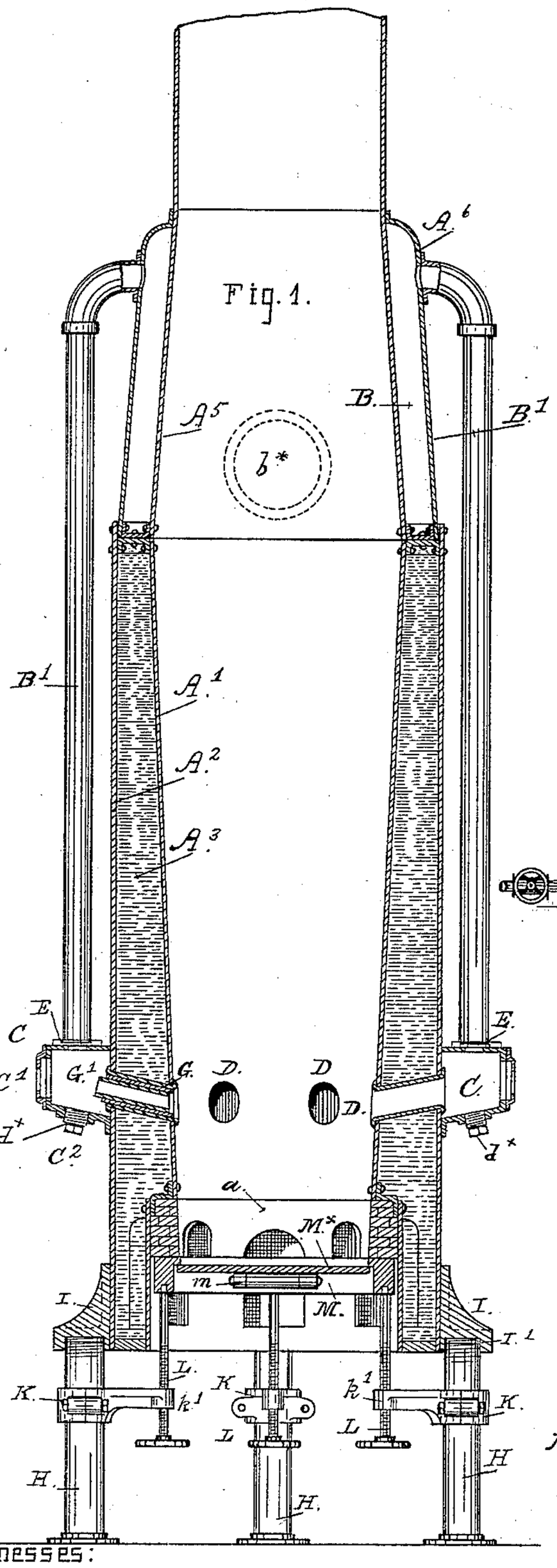
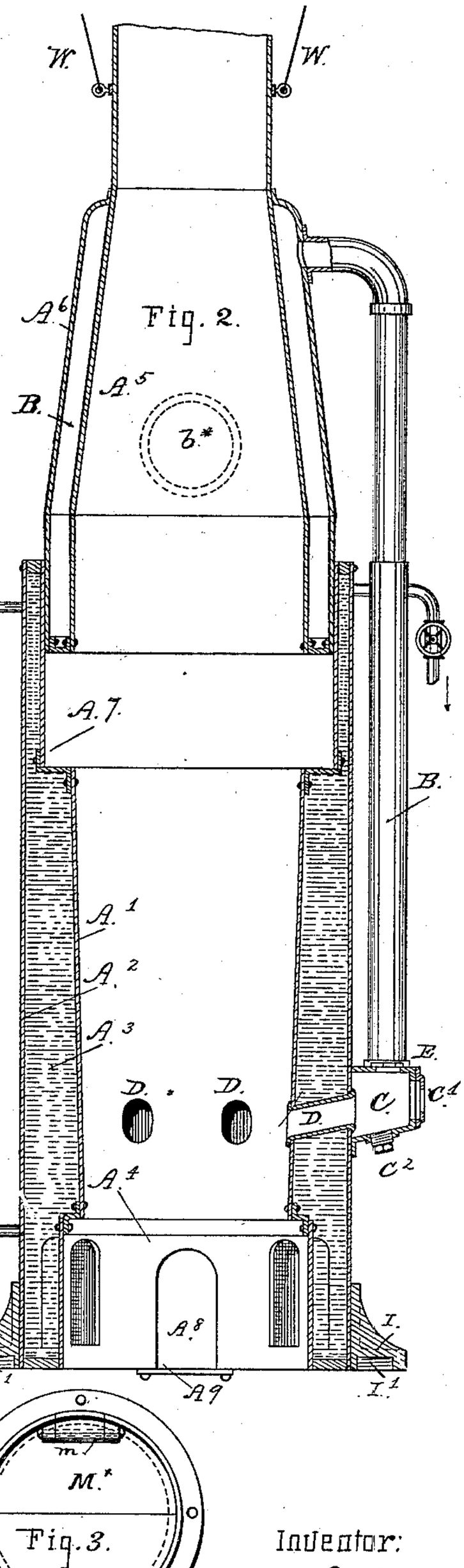


Fig. 2.



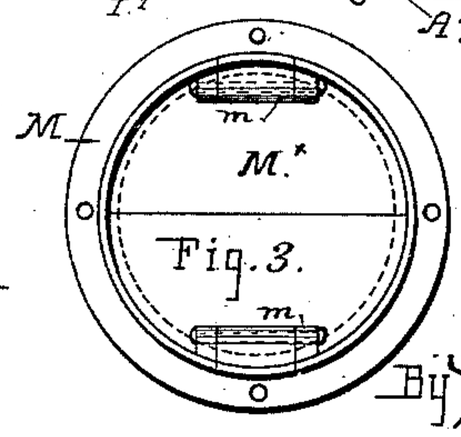


Fig. 3.

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(No Model.)

2 Sheets—Sheet 2.

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SMELTING FURNACE.

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Fig. 4.

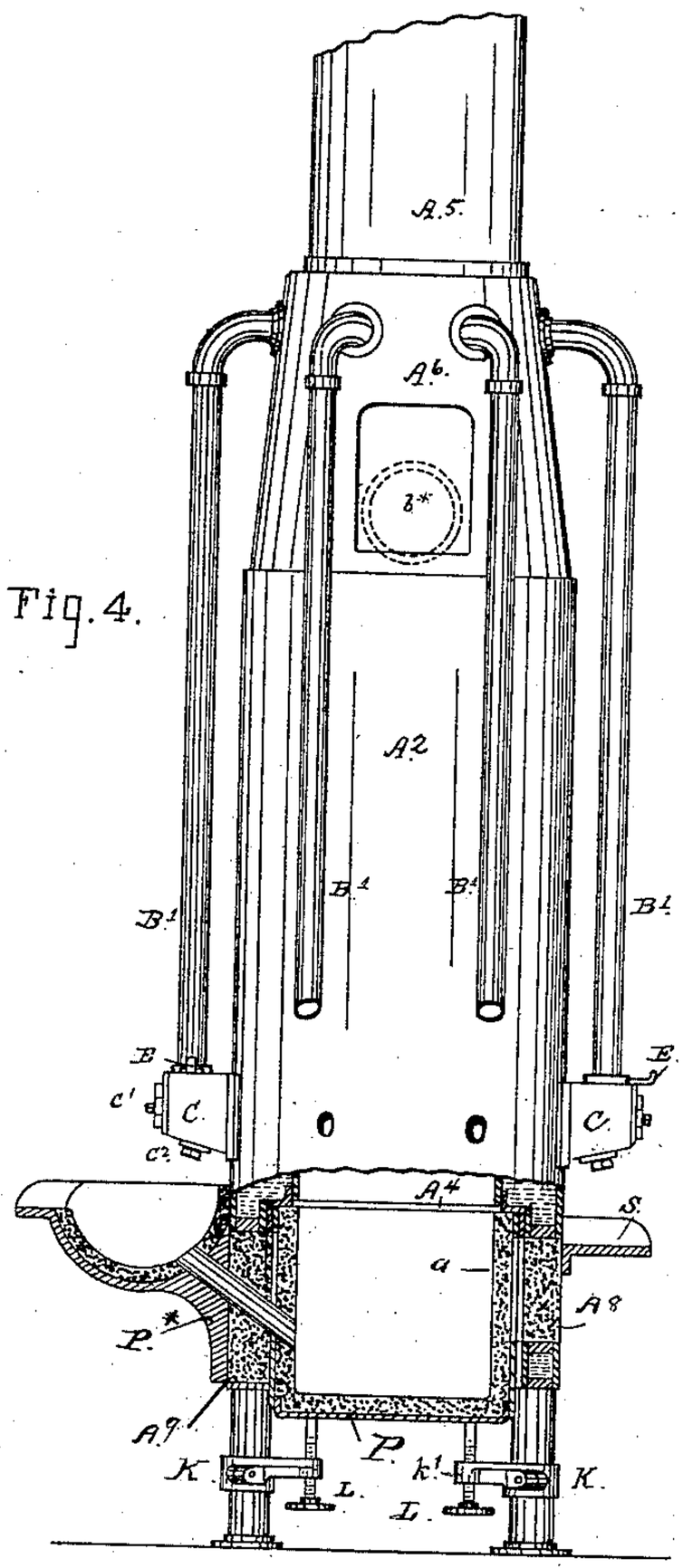
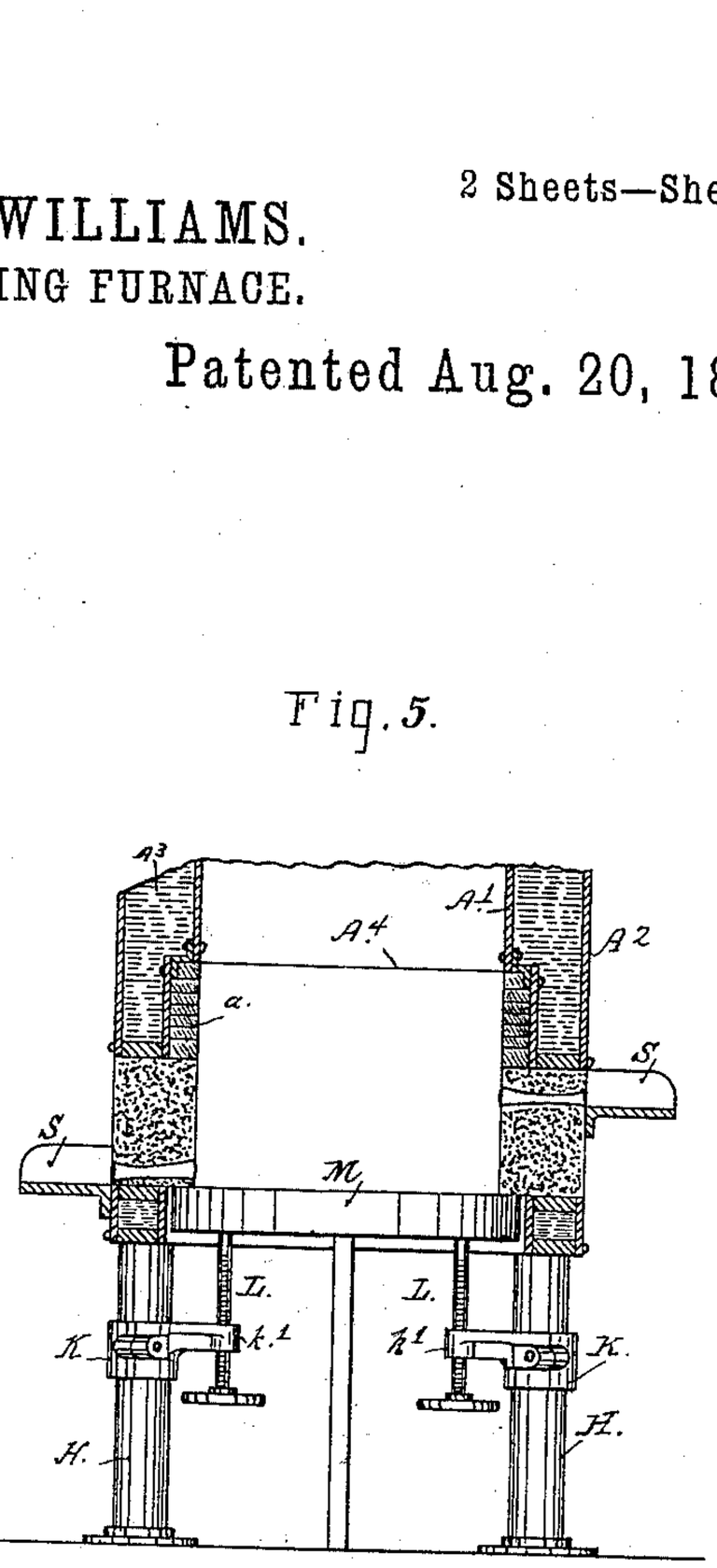


Fig. 5.



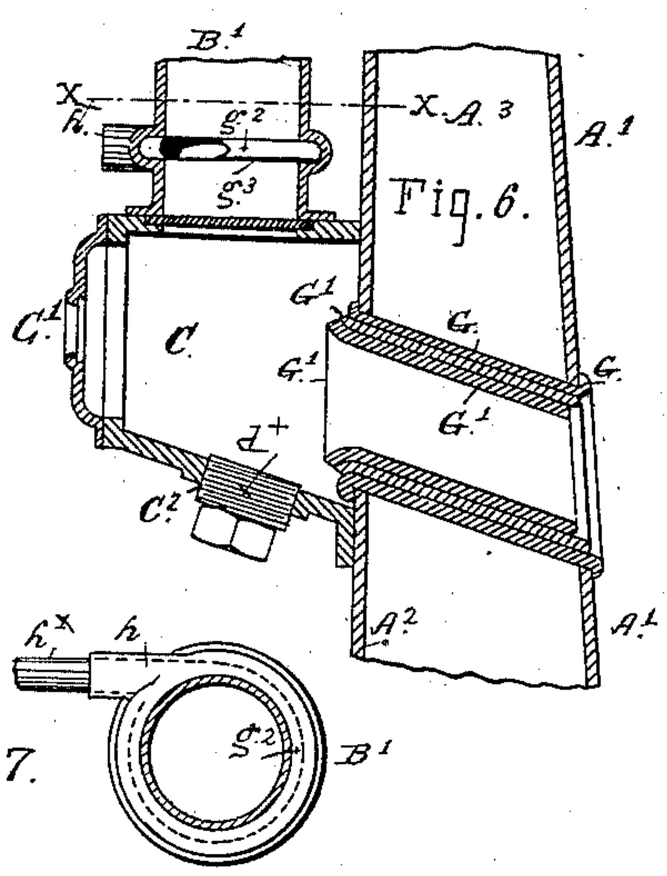


Fig. 6.

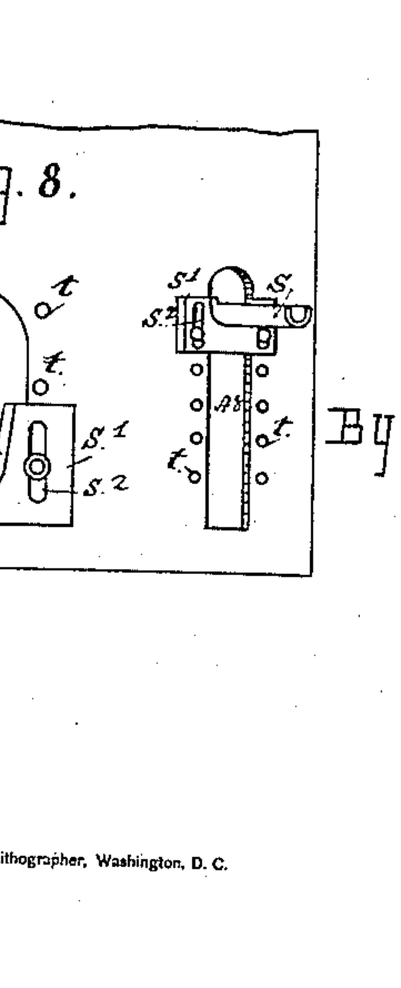
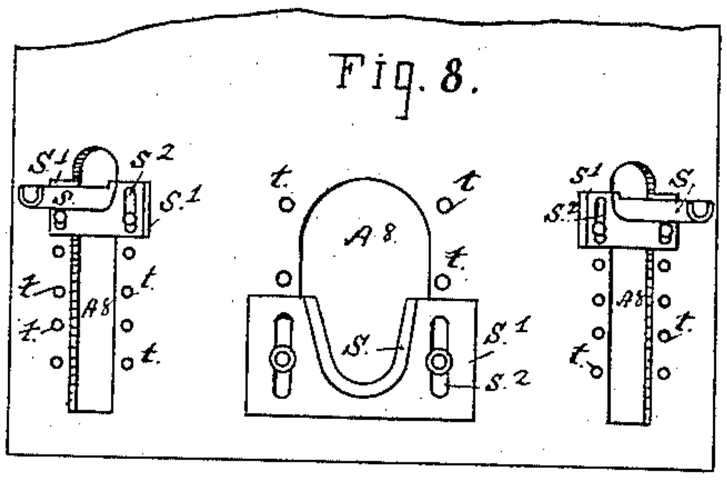


Fig. 7.

Fig. 8.



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UNITED STATES PATENT OFFICE.

JOHN J. WILLIAMS, OF SAN FRANCISCO, CALIFORNIA.

SMELTING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 409,541, dated August 20, 1889.

Application filed April 7, 1887. Serial No. 234,081. (No model.)

To all whom it may concern:

Be it known that I, JOHN J. WILLIAMS, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Smelting-Furnaces; and I do hereby declare that the following is a full, clear, and exact description of my said invention, and of the manner in which I construct, apply, and carry out the same, reference being had to the drawings which accompany and form part of this specification.

My invention relates to improvements in furnaces for smelting ores and carrying on other processes and operations in the treatment of ores and various substances in the arts where high heat is required. In these improvements are included certain novel construction and combination of parts, as hereinafter fully described, and the production of a furnace having features of adjustment and adaptation by which it can be used to work either copper or lead ores.

These improvements, constituting my said invention, consist, first, in utilizing the heat at the upper part of the furnace to raise the temperature of the air-blast before its introduction into the fire by forming an air-heating chamber around the upper part of the furnace-body and carrying the air from it, by means of pipes or individual conductors, down to the tuyere-boxes, the usual blowing apparatus being connected to this air-heating chamber. In connection with this part of my invention I provide separate tuyere-boxes and conductors having means for shutting off the air from any one of the tuyeres without disturbing the supply to the others or checking the operation of the furnace, and also means of access to a tuyere and its conductor through the tuyere-box for cleaning or repairing these parts. This feature includes also a tuyere composed of a stationary tube and removable tubular sections for increasing or diminishing the area of the tuyere-passage, and also means whereby such liquid fuel as petroleum is mixed with the heated air in the tuyere-box for introduction into the furnace.

The second part or feature of my improvements consists in making the bottom of the furnace adjustable up or down with respect to the line of tuyere-openings, whereby the depth of the metal-chamber can be varied to adapt the furnace to different processes or as called for by the particular kind or character of metal to be treated; also, in making this bottom removable; also, in providing adjustable spouts to change the height of the discharge-apertures and to afford outlets for slag, metal, and other products to be drawn off at different levels. In this part of my invention are embraced also certain novel constructions of a furnace-body with an offset or enlargement of the metal-chamber to take either a bottom plate or a crucible-bottom, and with a water-space extending down to the bottom of the chamber between it and the outer shell of the furnace.

The invention consists, finally, in the production of an improved furnace having capacity and features of change and adjustment to enable different ores and metals to be worked and treated in the same furnace, all as hereinafter fully set forth.

The drawings referred to as a part of this specification represent, in Figure 1, an elevation, generally in section, of a smelting-furnace constructed according to my said improvements with an air-heating chamber, separate conductors and tuyere-boxes, and an adjustable and removable bottom plate. Fig. 2 shows in similar view and section the construction of the furnace-body with the air-heating chamber detached from the body, and telescopic conducting-pipes for increasing or reducing the distance between the air-chamber and the locality of greatest heat in the furnace. Fig. 3 is an inverted plan of the removable bottom plate. Fig. 4 is an elevation, partly in section, of the furnace, set with a crucible-bottom for working lead ores. Fig. 5 is a section showing the position and general adjustment of bottom plate, furnace-lining, and discharge-spouts, as set for treating ores of more obdurate character than lead, such as copper, for instance. Fig. 6 is a detail on a larger scale through a tuyere-box, its pipe, and the furnace-shell at a tuyere.

Fig. 7 is a cross-section through the air-pipe at *x x*, Fig. 6. Fig. 8 shows the discharge-openings in the furnace-body and the adjustable spouts on the outside.

Similar letters of reference indicate corresponding parts in these views.

The furnace-body is constructed in the usual form, with an annular space for circulation of water between the two shells; but instead of having one shell terminate at the metal-chamber, or that portion of the space below the tuyeres in which the metal is collected, as has been the practice heretofore in furnaces of this class, it will be noticed that the inner shell extends down to the bottom of the body, and the water-space is carried down for the full depth of the metal-chamber between its wall and the outside shell of the furnace. The offset made in the inner shell to give space for the fire-brick or protective lining, as seen at Figs. 1 and 4, reduces the width of the water-space; but sufficient thickness of water-jacket is at the same time provided to protect the outer shell from injury by the heat under all conditions.

A′ A^2 are the inner and outer shells; A^3, the annular water-space, and A^4 the metal-chamber offset from the bottom of the fire-space.

B is an air-heating chamber at the upper part of the furnace, of which the stack or dome A^5 is the inner shell or wall in direct contact with the heat, and a jacket A^6, surrounding the stack, forms the outer wall.

B′ B′ are air-conducting pipes leading from this annular space down to the line of the tuyeres and terminating in separate tuyere-boxes C. These boxes are fixed on the outside of the body over the tuyeres D D, one independent of the others, and each box is provided with the usual aperture C′ in the front to give access to the tuyere from the outside, and in addition to this the box has an opening C^2 in the bottom closed by a screw-plug $d^{\times}$, which, when opened, gives access to the tuyere-box for breaking up and removing slag and accretions that collect and tend to fill the box under some conditions of work.

Connection of the blower is made to the chamber B in suitable manner to supply air at required pressure. In the present construction the supply-pipe enters the chamber at *b**, and by contact with the heated walls of this space its temperature is raised before it passes into the tuyeres. In some cases and under different conditions of operation it will be often of advantage to have this degree of heat under control, so that it may be increased or reduced or checked at times in the operation of the furnace, and I have, therefore, provided for such purpose a construction of air-heating chamber, as shown in Fig. 2 of the drawings, by which the chamber is made adjustable up and down with respect to the locality of greatest heat in the furnace, so that by changing its position toward or away from this point the action upon the air will be varied accordingly. In this construction the stack A^5 is separate from the body, and the shell A^6, surrounding it, forms the annular air-heating chamber B. The two shells join together at the bottom and set within the furnace-body into an offset A^7, corresponding in width to the size of the air-chamber at the bottom, so that the inner shell of the furnace and the inside wall of the stack are in line.

The conducting-pipes are formed of sections, telescoping together to connect the tuyere-boxes with the movable chamber under different conditions of adjustment; but this connection may also be made with a single section of pipe of suitable length to reach from the outlet-pipe at the air-chamber down to the opening in the top of the tuyere-box. Sections of different lengths are in such case provided for use as called for by the different positions into which the air-chamber is set. A counter-balance connected to the stack by chains W W, Fig. 2, sustains the weight of this movable stack.

A sliding valve E is placed in each air-pipe just above the tuyere-box to shut off the blast from any tuyere at will without disturbing the supply of air to the others; and the box of any tuyere can be opened at any time to clean out or repair a tuyere by simply shutting off the blast from that box without disturbing the operation of the furnace.

The tuyeres have removable tubes or bushings G′, regularly decreasing in size to fit one into the other, and as many of them are set into the fixed tube G as may be found necessary to reduce the area of the air-passage. They are removable through the tuyere-box and are readily taken out to enlarge the tuyere or inserted to reduce it as the material being treated is found to require. Figs. 1 and 6 illustrate this construction of tuyere with two removable tubes.

In order to augment the heat in the furnace at any time, as found to be necessary or desirable, I introduce petroleum or other liquid hydrocarbon into the air-blast just above the tuyere-box, and for this purpose I form in the air-pipe an annular liquid-channel g^2, Figs. 6 and 7, with a raised lip around the margin and an orifice g^3, terminating in a nipple *h*. Oil is supplied through a feed-pipe $h^{\times}$, connected to the nipple, and by overflowing the channel is caused to mix with and be taken up by the air in the tuyere-box on its way to the tuyere. The pipe $h^{\times}$ is connected with a suitable tank or supply located at a distance from the furnace, and suitable means is applied for injecting or forcing the oil against the pressure existing within the air-conductor. Air or superheated steam, either in the form of liquid or vapor, may be employed to inject the oil into the air-blast. Provision may be made for introducing the oil in this way into the blast at each tuyere

or to any number of conductors, as the character of substances to be worked in the furnace may call for.

The furnace-body is set directly upon pillars H, and the bed-plate heretofore used in furnaces of this character is dispensed with by fixing the lugs I I on the outside at the bottom to receive the ends of the pillars, screw-threads I′ in the lugs being provided to take threaded ends of the pillars, which may be removed for purposes of transportation. These supports are thrown outside of the line of the inner shell or wall of the metal-chamber to afford a clear opening through the bottom, without a ledge, rim, or other projection inside the face of the lining, and also to give space for setting as well as removing the supporting-bottom of the metal-chamber.

K K are sliding clamps on the pillars provided with elevating-screws L L, and M is an annular plate resting upon the ends of the screws, to which the two sections of a divided bottom plate $M^{\times}$ are attached by hinges *m m*, to open outwardly. In preparing the furnace for work this bottom is raised or lowered to give the required depth of metal-chamber, and the lining *a* is then set around the inside upon the annular plate and brought flush with the inner edge or rim of the opening. A clean discharge is then insured when the doors $m^{\times}$ are dropped.

To change the furnace from copper to lead ores, or for operations wherein a crucible form of bottom is desired, the bottom plate is removed altogether by loosening and dropping the clamps, and in its place is inserted the crucible P, as represented in Fig. 4, with a lead-well and siphon-discharge $P^{\times}$, for drawing off the metal, after the usual manner. This crucible is formed of a metal body and an interior lining *a*, the face of which sets flush with the inner wall of the furnace, and the same supports K L hold it in position. To insert the crucible from below in this manner, it is necessary to cut away one of the arches A^8 at the bottom, as at A^9, Fig. 2, in order to admit the lead-well, which is a part of the crucible and projects outside the furnace-body when set in position. The bottom of the arch is closed to give support to the clay filling *a* and to strengthen the lower ring by a plate set across the bottom and fastened by screws, as seen in Fig. 2, and is removable to set the crucible.

Fig. 5 of the drawings represents the furnace with the greatest depth of metal-chamber that can be obtained without substituting the crucible for the flat bottom plate. In this adjustment the spouts *s* are set at different heights to draw off the metal at the bottom and to discharge the slag at the upper part of the chamber, and under different positions and adjustment of the bottom to adapt the furnace for treating various kinds of ores and substances, wherein outlets at different levels are necessary, the spouts *s* require to be movable up or down accordingly. For this purpose the spouts are supported by flanges *s′* on the back, having slots s^2 to take over stud-bolts *t t*, set along the sides of the openings A^8 in the furnace in rows on both sides at intervals apart. Different positions are then given to any spout by removing it from one row of studs and setting it upon another above or below, or by shifting it upon the studs and setting up the nuts.

To those persons acquainted with the practical working of smelting-furnaces in the treatment of various ores and substances the advantages to be derived from the application and use of my said improvements will be clear from the foregoing description without more specific reference. For smelting either copper or lead the same furnace can be readily converted by removing one bottom and setting the other, and in any particular adjustment that may be called for the depth of the metal space or chamber can be varied by simply changing the height of the bottom and setting the spouts at the proper levels. With fixed bottom and stationary spouts having no vertical adjustment the depth of the chamber is limited and in every case requires to be made with reference to the line of the tuyeres and the location of the spouts.

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

1. In a smelting-furnace, the combination, with a stack, of an adjustable air-heating chamber located therein, and means for vertically adjusting said chamber, tuyere-boxes, and air-conductors connecting the air-heating chamber with the tuyeres, said conductors being extensible in length, as set forth.

2. In a smelting-furnace, an air-heating chamber and independent tuyere-box to each tuyere and an independent connecting-passage from the air-chamber to each box, said passage being provided near its connection with the tuyere with an annular liquid-channel g^2, having an orifice g^3, and an oil-pipe connecting the channel, all combined and arranged substantially as and for the purpose set forth.

3. In a smelting-furnace, a stack having a water-space between its inner and outer shells and provided with an offset-space in its upper portion, in combination with an air-heating chamber arranged to slide in said offset-space, and connections from said chamber to the tuyeres of the furnace, as set forth.

4. In a smelting-furnace, the combination, with a double-walled stack having vertical openings in its walls near the base thereof, of spouts extending through the two walls, and provided with back plates resting against the outer wall, said back plates having vertical slots therein and screws extending through the slots for holding the spouts at any elevation in the openings, as set forth.

5. In a smelting-furnace, a stack having

vertical openings in its walls, and spouts extending through said walls and having vertically-slotted back plates resting against the outside thereof, with screws therein for holding the spouts at any adjustment, in combination with an adjustable metal-chamber in the base of the stack, as set forth.

In testimony that I claim the foregoing I have hereunto set my hand and seal.

JOHN J. WILLIAMS. [L. S.]

Witnesses:
EDWARD E. OSBORN.
JAMES L. KING.