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R. BAGGALEY.

APPARATUS FOR REMOVING IMPURITIES FROM FURNACE GASES.

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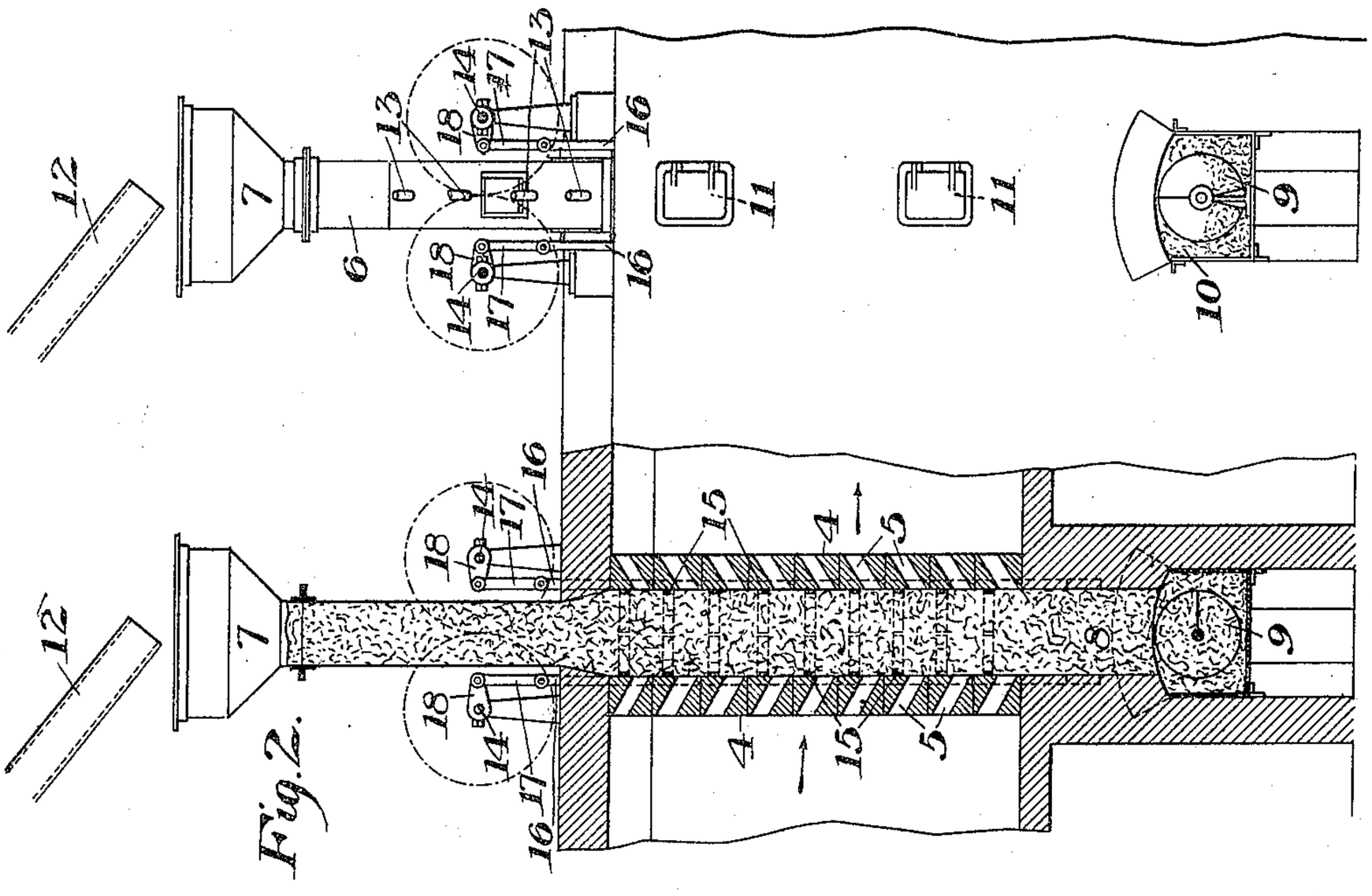

Fig. 2.

Fig. 1.

Fig. 3.

WITNESSES

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APPARATUS FOR REMOVING IMPURITIES FROM FURNACE-GASES.

No. 846,815. Specification of Letters Patent. Patented March 12, 1907.

Original application filed September 24, 1903, Serial No. 174,432. Divided and this application filed November 27, 1903. Serial No. 182,747.

To all whom it may concern:

Be it known that I, RALPH BAGGALEY, of Pittsburg, Allegheny county, Pennsylvania, have invented a new and useful Apparatus for Removing Impurities from Furnace-Gases, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a vertical cross-section of apparatus embodying my invention, the section-plane extending through one of the charcoal-containing chambers. Fig. 2 is a side elevation partly in vertical longitudinal section. Fig. 3 is a perspective view, on a larger scale, showing the cutter-bar mechanism for removing from the walls incrustations deposited from the furnace-gases.

My invention is designed to prevent the devastating effects to vegetation and to the streams arising from the smelting of copper ores containing sulfur, arsenic, &c. It is well known that the country surrounding smelting plants, sometimes for many miles distant, is devastated through the destruction of vegetation by the fumes inseparable from the fusion of sulfid ores.

In a furnace smelting three hundred and sixty tons of ore that contains, say, twenty per cent. of sulfur from sixty of seventy-five tons of sulfur are volatilized daily and of course deposited in the surrounding country. On damp or rainy days the sulfur will fall within a short distance of the smelter-stack. On clear days it will often be carried for a distance of fifteen or twenty miles. The result is the same wherever it falls. Vegetation is destroyed, and the sulfur is carried by the surface drainage into the streams and ponds and the water is polluted and rendered unfit for use. A still more injurious effect is produced when the ores contain arsenic, which is also volatilized and when carried into the streams renders the water poisonous. So serious has this become that it is impossible to operate smelting plants and to conduct agriculture successfully in the same district. My invention is intended not only to prevent in an economical manner these objectionable features of the smelting industry as at present practiced, but at the same time when desired to collect as by-products sulfur and arsenic or other elements of the ore that have heretofore been wasted.

My invention is founded on the fact that charcoal will absorb from forty to fifty times its volume of sulfur and sulfur-dioxid gases. In the smelting of sulfid ores approximately one-half the sulfur contents of the ore pass off in the form of free sulfur. The remaining gases contain from fourteen to fifteen per cent. of sulfur dioxid and are practically identical with the gases produced by roasting pyrites in the kilns employed in sulfuric-acid manufacture. I have found that by interposing charcoal screens or filters within enlarged chambers located between the smelting-furnace and the stack or located between the smelting-furnace and a suitable fan or other mechanical device for producing an induced draft these obnoxious sulfur-fumes will be absorbed effectually up to the point where the charcoal has been increased approximately twenty per cent. of its weight. Above this point the sulfur-fumes are not entirely arrested. Therefore if it is desired in practicing my invention to remove all of the sulfur from the fumes the charcoal must be changed whenever its weight has been increased by such deposit and absorption approximately twenty per cent. In ordinary practice it will not be necessary to eliminate all of the sulfur. If twenty per cent. of the sulfur-fumes, for example, is allowed to escape, the fumes will be so dilute as to readily become dissipated in the atmosphere without serious injury to the surrounding country.

In a furnace that smelts three hundred and fifty tons of ore in twenty-four hours containing, say, twenty per cent. of sulfur the daily output of sulfur released, either in the free state or as sulfur-dioxid gas, will approximate sixty tons. Theoretically this would require for purification of the gases a ton and a half of charcoal daily. In my apparatus I provide successive filters, preferably three in number, each containing from two to two and a half tons of charcoal. These should be located far enough from the smelting-furnace to prevent ignition from the hot gases. I have found that charcoal is subject to what is called in the trade "spontaneous combustion," which I believe to be caused by the occurrence of red-hot centers protected from

the atmosphere by a casing of cold non-conducting charcoal and which when exposed to air burst into flame. It is therefore of importance that provision be made for drenching the charcoal screens from above with water. It is also important on account of the large and rapid deposit of impurities from the gases that the charcoal filtering material be renewed frequently, and for this purpose I provide the chambers which contain such material with mechanism situated in the column of filtering material for effecting positively the removal of such material, either continuously or intermittently, as desired, and as the material is thus removed from the bottom of the chamber fresh material is introduced thereinto at the top. When the charcoal has been removed, I preferably introduce it into a steam retort or tank, where the contained sulfur is melted out by means of steam under a pressure of approximately fifty pounds to the square inch. This yields a temperature of approximately 300° Fahrenheit, and as sulfur melts at 239° Fahrenheit it is apparent that the sulfur is thus removed from the charcoal and the charcoal rendered capable of being used again for the same purpose. The third screen provided in my apparatus also contains charcoal which is constantly drenched or saturated either with a dilute solution of sulfid of calcium or with a simple alkaline solution of any kind that can be cheaply and readily obtained. Such solution can be used many times and will effectually throw down and arrest the arsenic contained in the gases. By resubliming the sulfur in the steam-retort above referred to it may be freed from all bases, impurities, lead, zinc, &c., excepting arsenic. Should the sulfur be found to contain arsenic in any appreciable percentage, it will not be fit for use; but the arsenic can be eliminated by suitable treatment.

In order to secure the most effective results in the operation of apparatus such as described above, it is necessary to provide means for removing the incrusted impurties from the walls. A portion of the deposited impurities will precipitate as a hard mass in the flues on the interior of the flue-walls, and especially around the interior edges of each flue, and as the tonnage precipitated is very great such accumulations of incrustations, &c., are necessarily quite rapid, and in time projections of precipitated material on the interior of the flue-walls will interfere with and obstruct the draft and in time may clog and obstruct the travel of the screens. It is important that these obstructions be quickly and cheaply removed from the interior walls so often as may be desired and in such a manner that the apparatus will not be thrown out of service or its successful working be delayed or interfered with. It is also of importance that this work should be accomplished without manual labor. I effect the removal of these hard incrustations by the use of cutter-bars actuated by suitable mechanism which maintains them in motion along the surface of the flue-walls, so that they will forcibly dislodge the incrustations, and thus keep the flues freely open for the passage of the gases.

In the drawing, in which I show the preferable construction of my apparatus, 3 is a chamber connected at one end with the downcomer pipe of a smelting-furnace and at the other end communicating with a stack or other means for drawing the smelter-gases rapidly through it.

The chamber is provided at intervals with the screens above mentioned. Each screen is formed by vertical double walls 4 4, having perforations 5 5, which are inclined upwardly in order to prevent loss of the charcoal contents and offer free passage to the smelter-gases. Each screen-chamber has at its upper end a feeding-space 6, preferably formed with upwardly-converging walls and communicating with a feed-hopper 7, and at its lower end it terminates in a space 8, provided with a screw conveyer 9 or like discharging mechanism adapted to discharge the screen material at an opening 10. This conveyer is situated in the base of the vertical column of filtering material, so that it is effective to cause a ready removal of the material notwithstanding the very large amount of impurities which are deposited upon the particles of material and which, consisting largely of sulfur and sulfur compound, would otherwise tend to cause the scaffolding of the material and its lodgment within the screen-chamber. Owing to the large volume of binding-agents which are deposited upon the filtering material from the copper-smelter gases, it is essential that the screw conveyer be placed in the vertical column, for otherwise the material would clog or scaffold, as above stated. In this respect my apparatus differs from all others heretofore proposed. At the ends of the screen spaces or chambers are openings 11, fitted with suitable doors and adapted to permit the admission of a poking-tool when it is desired to facilitate the discharge of the contents. At the upper end of each screen-chamber are pipes 13, by which water or alkaline solution may be introduced in quantities, as desired. The fresh charges of charcoal are fed into the hopper by spouts or chutes 12, which lead from suitable sources of supply, so that the feeding and discharge of the charcoal may be effected without manual labor. In use of

the apparatus the screen-chambers between the perforated walls are filled with charcoal introduced through the hoppers, and the charcoal of the third screen is kept drenched from the pipe 13 by a simple alkaline solution or a solution of sulfid of calcium for the sole purpose of precipitating any arsenic.

In order to present fresh charcoal surfaces to the gases from time to time, a part of the charcoal is withdrawn at the bottom of the screen-chambers, its place being taken by charcoal fed through the hoppers, the rapidity of the withdrawal of the charcoal being governed by the percentage of impurities contained in the ores under treatment. By causing the charcoal to pass rapidly through the column the danger of scaffolding can be prevented, and, if desired, the charcoal can be passed repeatedly through the column by reintroducing it at the top of the column as it is removed from the base thereof.

The cutters by which the hard incrustations deposited on the walls are dislodged are preferably constructed as follows: 15 15 are bars which extend horizontally across the screen-chamber and are connected by vertical rods 16, set in grooves in the masonry walls and adapted to be reciprocated by links 17 from cranks 18 on shafts 14. The bars 15 may be made of hard wood faced with brass or other material not corrodible by the furnace-gases, or they may be made entirely of brass. The bars on opposite sides of the screen-chambers are moved by the cranks in opposite directions, and thus constantly free the interior of the chamber from incrustations, allowing the filtering material to drop readily without obstruction. The upright bars or rods which carry the cutter-bars are sunk in vertical grooves in the walls of the flues, in which manner they are protected from the action of the gases and are also partially protected from the action of the water and the alkaline solutions on the filtering material. Each cutter-bar when at rest is shielded and protected from the action of the gases by reason of its position between the flue-mouths. Each upright bar is provided with guides both above and below that hold it rigidly in the exact position necessary to enable the cutter-bars to do the most effective work in their mission of removing such incrustations and precipitated materials. The cutter-bars themselves may work continuously and slowly or intermittently and rapidly, as may be found in practice to best suit the work and to produce the most economical results in each plant where my invention may be utilized, and at the corners of the screen-chambers the cutter-bars may be given an angular form, as shown in Fig. 3, in order to operate upon the end walls of the chambers as well as upon the side walls.

The present application is a division of an application filed by me on September 24, 1903, Serial No. 174,432.

I claim—

1. Means for removing impurities from copper-smelter gases, comprising a vertical column of screening material interposed across the path of the gases, means for supplying fresh material to the top of the column, and a conveyer situated directly in the base of the column, the said column being unobstructed throughout its height and resting upon the conveyer, whereby the screening material may be moved in the column and removed from its base with sufficient rapidity to prevent scaffolding; substantially as described.

2. Means for removing impurities from copper-smelter gases comprising a chamber connected with the gas-outlet of a copper-smelting furnace, and a screen arranged in said chamber, said screen consisting of perforated walls inclosing a vertical space between them having a cross-section, no part of which is of less area than its upper end, a column of granular material in said space and free to move downwardly therein, together with means for supplying material to the upper end of the column and removing it from the lower end; substantially as described.

3. Means for removing impurities from copper-smelter gases, comprising a chamber into which the gases are led from the smelter, a screen interposed in said chamber, said screen consisting of a straight vertical column of granular material inclosed between perforated lateral walls, and a conveying device at the base of the column, the cross-sectional area of the column where it discharged to the conveyer being unrestricted, whereby the column is free to move downward as fast as its lower portion is removed by the conveyer; substantially as described.

4. Means for removing impurities from copper-smelter gases, comprising a chamber to which the gases are led from the smelter, and a vertical screen in said chamber transverse to the passage of the gas, said screen comprising parallel vertical walls having unobstructed inner surfaces and formed with upwardly and outwardly directed perforations or openings, a column of granular material between said walls and extending unobstructedly below the same into an enlarged conveyer-chamber, and a conveyer upon which the base of the column rests; substantially as described.

5. Means for removing impurities from copper-smelter gases, comprising a chamber to which the gases are led from the smelter,

and a vertical screen in said chamber transverse to the passage of the gas, said screen comprising parallel vertical walls having unobstructed inner surfaces and formed with upwardly and outwardly directed perforations or openings, a column of granular material between said walls, and extending unobstructedly below the same into an enlarged conveyer-chamber, and a conveyer upon which the base of the column rests, together with means for spraying the column and for supplying fresh material to its upper end; substantially as described.

In testimony whereof I have hereunto set my hand.

RALPH BAGGALEY.

Witnesses:
WILLIAM M. KIRKPATRICK,
W. D. KYLE.