S. W. SMITH.

FUME CONCENTRATOR FOR SMELTERS.

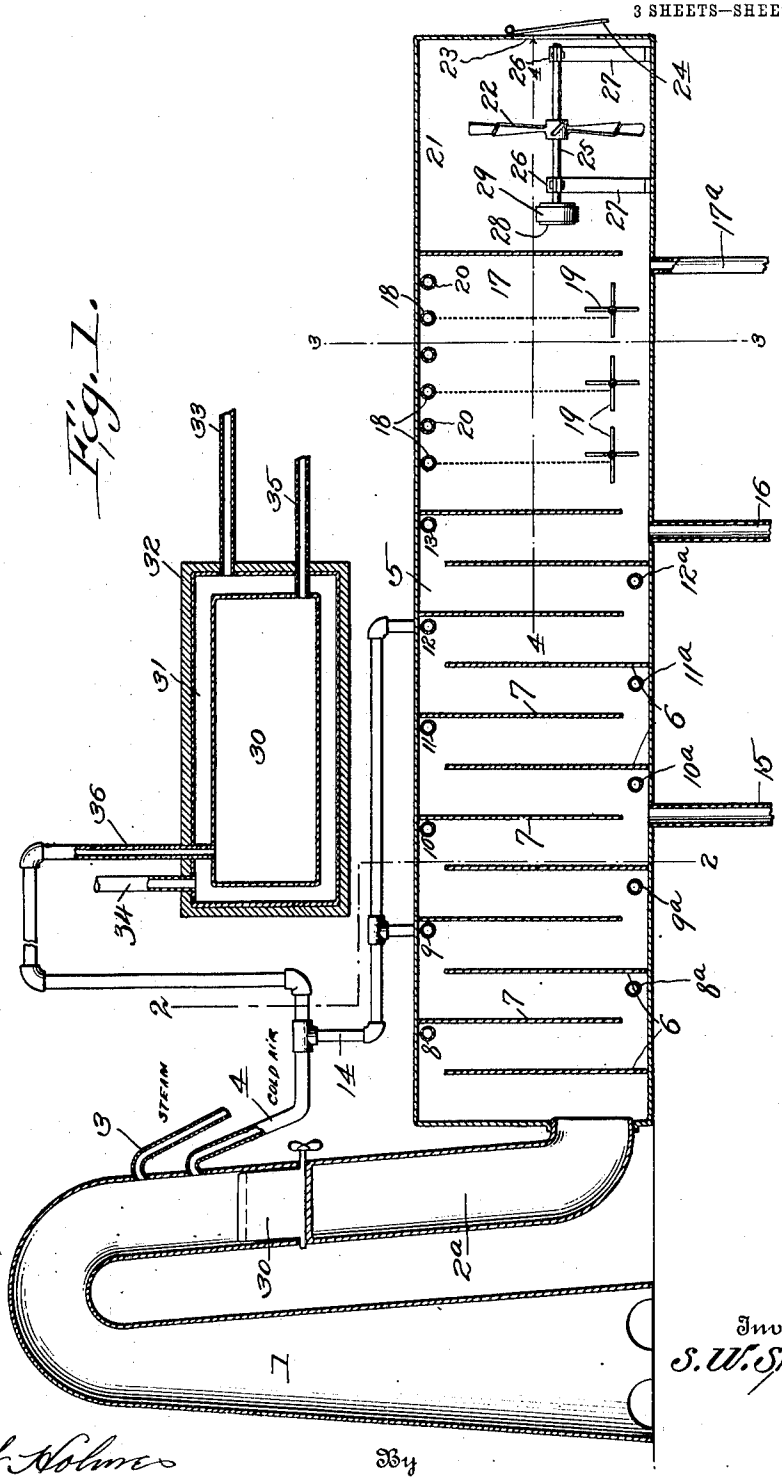
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1,112,860.

Patented Oct. 6, 1914.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses

Alvin W. Holmes

Edw. R. Watson Jr.

Inventor

S. W. Smith

By

Attorney

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3 SHEETS—SHEET 2.

Fig. 2.

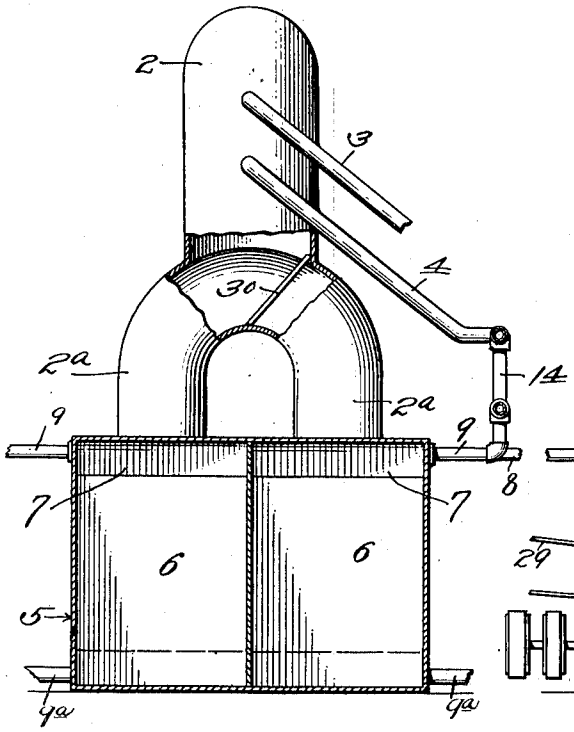


Fig. 3.

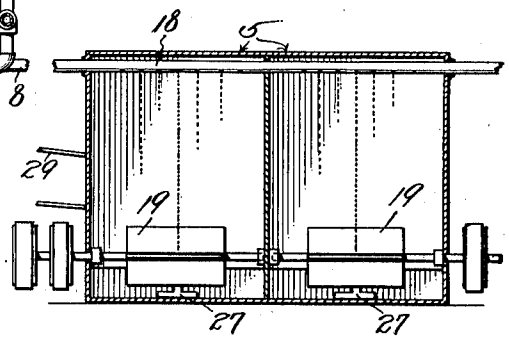
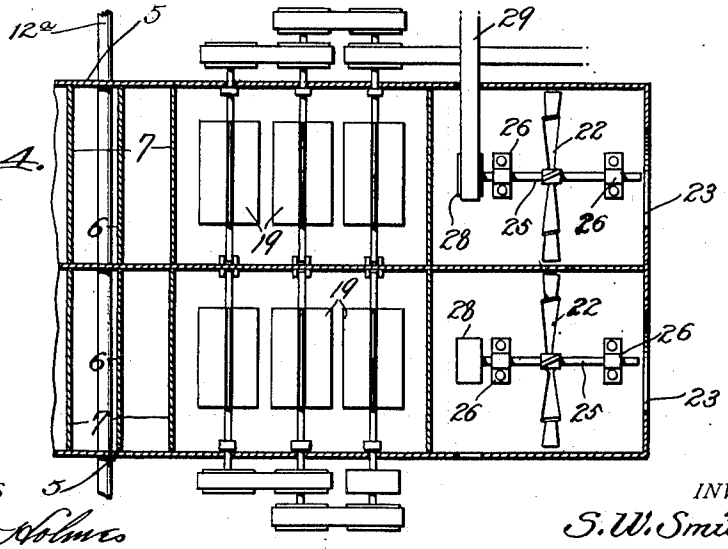


Fig. 4.



WITNESSES

Alvin W. Holmes

E. A. Walton, Jr.

INVENTOR

S. W. Smith

Attorney

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3 SHEETS—SHEET 3.

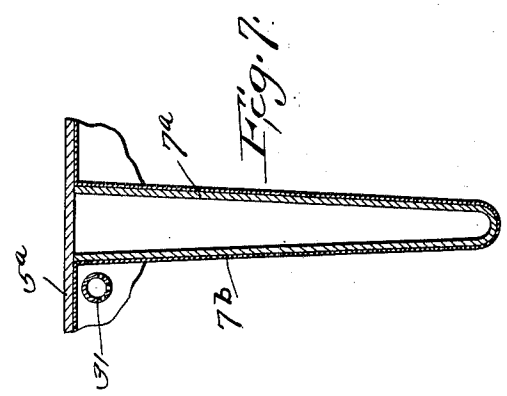


Fig. 7.

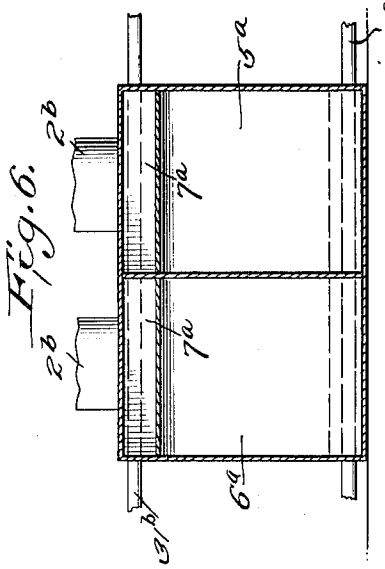


Fig. 6.

Fig. 5.

WITNESSES

Alice H. Holmes

E. R. Hatton Jr.

INVENTOR

S. W. Smith

Attorney

UNITED STATES PATENT OFFICE.

STEPHEN W. SMITH, OF SAN JOSE, CALIFORNIA.

FUME-CONCENTRATOR FOR SMELTERS.

1,112,860. Specification of Letters Patent. Patented Oct. 6, 1914.

Application filed March 9, 1912. Serial No. 682,770.

To all whom it may concern:

Be it known that I, STEPHEN W. SMITH, a citizen of the United States, residing at San Jose, in the county of Santa Clara and State of California, have invented certain new and useful Improvements in Fume-Concentrators for Smelters, of which the following is a specification.

The present invention relates in general to a fume concentrator which is adapted to be employed in connection with smelting furnaces for the purpose of eliminating from the fumes emanating from the smelter all of those chemical reagents which would otherwise prove obnoxious to vegetable and animal life in the vicinity of the smelter.

The smelting of ores is a very important industry in many parts of the country, although in some sections the inhabitants have found it necessary to take legal proceedings and have the operation of the smelters stopped, owing to the fact that the fumes liberated from the smelters float away for many miles and prove obnoxious to animal and vegetable life to such an extent as to entirely divest large areas of all vegetation and become deleterious to animal existence. Large sums of money are tied up in some of these smelting plants which are forced to remain idle because no satisfactory means has yet been provided for acting upon the fumes to remove the harmful properties therefrom.

The object of the present fume concentrator has accordingly been to correct this evil by so trapping, holding and treating the fumes with steam, cold water, cold or refrigerated air, and appropriate chemical reagents, as to precipitate many, if not all of the obnoxious elements therein, and finally by forcing the fumes through a bath of cold water spray to entirely cleanse the residual fumes of all detrimental elements.

With these and other objects in view, the invention consists in certain novel combinations and arrangements of the parts as will more fully appear as the description proceeds, the novel features thereof being pointed out in the appended claims.

For a full understanding of the invention, reference is to be had to the following description and accompanying drawings, in which:—

Figure 1 is a longitudinal sectional view through a fume concentrator constructed in accordance with the invention. Fig. 2 is a vertical sectional view on the line 2—2 of Fig. 1. Fig. 3 is a transverse sectional view on the line 3—3 of Fig. 1. Fig. 4 is a horizontal sectional view on the line 4—4 of Fig. 1. Fig. 5 is a longitudinal sectional view through a modified form of fume concentrator which is constructed in accordance with the invention. Fig. 6 is a transverse sectional view on the line 6—6 of Fig. 5, and Fig. 7 is an enlarged sectional view through one of the hollow baffle members.

Corresponding and like parts are referred to in the following description and indicated in all the views of the drawings by the same reference characters.

Specifically describing the present embodiment of the invention, the numeral 1 designates a smelter which may be of any suitable construction, and 2 a large conduit which serves to conduct the fumes from the exit of the smelter to the fume concentrator. As shown more clearly in Figs. 2, 3 and 4, the fume concentrator is preferably formed in duplicate so that the two parts thereof can be used alternately. The lower end of the conduit 2 is formed with a pair of branches 2^a which lead to duplicate compartments 5 through which the fumes are caused to pass. A valve 30 is provided at the junction of the two arms 2^a of the conduit 2. This valve can be swung in either direction so as to shut off either one of the branches from communication with the conduit, or can be moved to an intermediate position so as to leave both of the branches 2^a in communication with the conduit. With such a construction the operation of the smelter can be continuous, since one side of the fume concentrator can be cut off from the smelter and opened up for cleaning and repairing, while the opposite side of the fume concentrator is in operation. Steam may be introduced into the conduit 2 through the medium of a steam pipe 3, the said steam serving to combine with the acid gases to produce acids and to unite with the anhydrids of sulfur, chlorin, fluorin, bromin, and other caustic acid or basic reagents. Cold or refrigerated air 4 may also be introduced into the conduit pipe 2 through the medium of a cold air pipe 4, the said cold air serving to reduce the temperature of the fumes.

The branches 2^a at the lower end of the pipe 2 communicate with respective compartments 5 through which the fumes are

caused to pass. The fumes are caused to travel in a tortuous path through the chambers or compartments 5, and for this purpose a series of partitions or baffles 6 extend upwardly from the bottom thereof while a series of partition or baffles 7 project downwardly from the top of the chamber. The partitions 6 and 7 are arranged alternately so that the fumes in passing through the compartments 5 must successively pass upwardly over the ends of the partitions 6 and then downwardly under the ends of the partitions 7. It is contemplated to introduce various reagents into the compartment 5 at various points in the length thereof, the said reagents serving to act upon the fumes to partially or completely eliminate the obnoxious properties thereof. For this purpose a series of reagent pipes 8, 9, 10, 11, 12 and 13 are shown as extending transversely across the top of the compartment or chamber 5 immediately in front of each of the downwardly extending partitions 7. Wet steam, cold or refrigerated air, or suitable chemical reagents would be introduced into the chamber 5 through these various reagent pipes so as to mingle with and act upon the fumes as they strike against and circulate around the baffles formed by the partitions 6 and 7. In the present instance the reagent pipes 9 and 12 are shown as in communication with the cold air pipe 14, and wet steam or any suitable chemical reagents, depending upon the chemical properties of the fumes, would be introduced into the chamber through the remaining pipes. If desired, an additional series of reagent pipes 8^a, 9^a, 10^a, 11^a, 12^a and 13^a can be located at the bottom of each of the compartments 6, those reagent pipes at the bottom of the compartment being arranged alternately with respect to the reagent pipes at the top of the compartment. Reagents would be introduced into the compartment through the lower set of pipes in substantially the same manner as they are introduced into the top of the compartment, the character and quantity of the reagent being regulated as found necessary to produce the best results. This chamber 5 may be of any suitable length and dimensions, and any suitable number of reagent pipes may be provided. The same reagent may be introduced into the chamber through several of the pipes so as to act successively upon the fumes, or different reagents may be introduced through the different pipes, as may be required. Traps 15 and 16 are provided at intervals in the bottom of the chamber 5 for the purpose of carrying away any liquids or solids which may be precipitated upon the bottom of the chamber. From the compartment 5 the fumes enter a compartment 17 in which they are further acted upon by a spray of cold water. A series of perforated pipes 18 extend transversely across the top of the compartment 17 and the water drops from these pipes upon revolving paddles 19 which act upon the falling water to produce a fine spray which entirely permeates the compartment or chamber 17 so as to further purify and wash the fumes. Reagent pipes 20 may also be provided in the top of the chamber 17 for the purpose of introducing any further reagent which may be necessary to complete the concentration or purification of the fumes. From the chamber or compartment 17 the fumes pass into a compartment 21 having a suction fan 22 mounted therein, the said suction fan serving to draw the fumes through the fume concentrator and force the same outwardly through the discharge opening 23. A suitable damper 24 is provided for the discharge opening, and the draft and flow of fumes through the concentrator can be regulated by suitably adjusting this damper. The fan 22 may be of any suitable construction and mounted in any suitable manner although in the present instance it is shown as carried by a shaft 25 journaled in bearings 26 at the upper ends of standards 27. A pulley 28 is applied to the shaft 25 and receives power from some suitable source through the medium of a belt 29.

In order to lower the temperature of the fumes to that point necessary to obtain the best results, it may be necessary to provide refrigerated air and introduce the same into the fume concentrator at a temperature below the freezing point. For this purpose an air refrigerator is shown diagrammatically in Fig. 1, the said air refrigerator comprising an air tank 30 adapted to hold compressed air at a pressure of 100 to 250 pounds per square inch, the said tank 30 being surrounded by a chamber 31 into which ammonia or other refrigerating gas can be pumped. Insulating material 32 surrounds the chamber 31 to prevent the ammonia from absorbing heat from the outer air. The ammonia or other refrigerating gas can be pumped into the chamber 31 through a pipe 33 and withdrawn therefrom through a pipe 34. The air could also be forced into the air tank 30 through an air inlet pipe 35 and withdrawn therefrom through an air outlet pipe 36. When this compressed refrigerated air is introduced into the conduit or fume chamber, the rapid expansion thereof increases the effectiveness of the refrigerated air in absorbing the heat of the fumes. The use of this refrigerated air would enable the device to be successfully employed in hot climates as well as cold climates, since in a warm climate the ordinary cold air would hardly be sufficient to act effectively upon the fumes. An important feature to be considered at this point is the fact that there

are two kinds of heat to be eliminated from the fumes, first the sensible heat of the furnace and of chemical combinations, and second the latent heat of all bodies in a gaseous form. Cold air will answer the purpose if it is sufficiently cold, although in an extremely hot climate it would be necessary to refrigerate the air, since unless the fumes are properly cooled the gases will not condense.

In the operation of the device, the fumes will first be acted upon in the conduit 2 by the wet steam and the cold or refrigerated air injected through the pipe 4. The steam partially furnishes water to the otherwise dry or anhydrous gases and alkalis, while the cold air tends to cool the same. This process is not complete in the conduit 2, however, and additional charges of steam and cold air, as well as other suitable chemical reagents are introduced at suitable intervals as the fumes pass through the chamber 5. This continuous and repeated action of the reagents upon the fumes tends to effectively reduce the same and remove the obnoxious properties. The moisture from the steam combines with the acid gases to produce acids, while the cold air reduces the temperature so as to condense the products of the chemical reactions, any liquid which may collect upon the bottom of the chamber 17 being caught in the traps 15 and 16. In the chamber 17 the residual fumes are washed with cold water which is dashed into a spray. This cold water serves to remove any oxid of lead, tin, zinc, copper, silver, gold, or other metal. Any liquids which might be condensed upon the floor of the chamber 17 would be caught in a trap 17^a. The various revolving fans or beaters 19 may run either singly or in multiple, and may be geared up in any suitable manner as indicated by Fig. 4.

Attention is directed to the fact that each step in the process serves to prepare the fumes for the next step, the fumes being thus thoroughly acted upon step by step as they pass through the concentrator. When the fumes finally emerge, they are free from all elements or properties which would tend to render them injurious to animal or vegetable life.

This fume concentrator can be made in any desired size, and the length of the various compartments can be increased or decreased as desired, or as may be found necessary to produce the best results in connection with the fumes being operated upon. As previously stated, the fume concentrator is constructed in duplicate, as indicated in Figs. 2, 3 and 4, although both parts thereof are exact duplicates of each other, and a description of one part is sufficient for both parts. In practice a long low building would probably be employed, the said building being divided by a longitudinal partition into two separate compartments, the said compartments being each fitted out as independent fume concentrators.

A modification of the invention is shown in Fig. 5, in which the numeral 1^a designates the stack of a smelter and 2^b a conduit leading from the stack 1^a to a fume treating compartment 5^a. This compartment may be constructed of any suitable material, although it is contemplated to form the walls of sheet metal which is heavily coated with some suitable enamel adapted to resist the action of the acids, said enamel being indicated upon Fig. 7 by the character 7^b. A series of baffles 6^a project upwardly from the bottom of the compartment 5^a, while a similar set of baffles 6^a extend downwardly from the bottom of the compartment, the baffles 6^a and 7^a being arranged alternately with respect to each other so that the fumes will be forced to travel through the compartment in a tortuous path. Particular attention is directed to the fact that the baffles 6^a and 7^a have a hollow formation and are adapted to receive some cooling medium such as refrigerated air or cold water. These baffles may be constructed of any suitable material, such as sheet iron with the exposed surface thereof heavily enameled or otherwise coated with acid resisting material. A series of reagent pipes 31^b may be arranged in the top of the compartment 5, and if desired a second series of reagent pipes 31^a may be arranged in the bottom of the compartment 5, the arrangement of these pipes being substantially the same as set forth in the former embodiment of the invention. Steam, cold or refrigerated air, and other suitable reagents would be introduced into the compartment through the medium of these pipes so as to act upon the fumes and eliminate the obnoxious properties therefrom. The chamber 5^a might be made of sufficient length to thoroughly cool and act upon the fumes without the necessity of providing a water bath, such as is employed in the former construction. It should be stated, however, that the water bath is by no means necessary to the treatment of the fumes, and is merely a subsidiary element of the invention, the essential feature of the invention being the simultaneous cooling of the fumes and treating the same with reagents, so as to render the fumes harmless without the necessity of depending upon washing the fumes. The use of a small quantity of water might be advantageous in certain instances, although it is not absolutelv necessary in carrying out the invention, one of the objects of the invention having been to provide a means for treating the fumes without the use of water, since in most States there are laws prohibiting the passage of this water from smelters into streams or other bodies of water. A

compartment 21^a is shown as receiving the fumes from the compartment 5^a, the said compartment having a fan 22^a mounted therein. This fan 22^a is substantially the same as the fan 22 previously described, and acts in identicallv the same manner to produce suction and bring about a positive movement of the fumes through the concentrator.

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

1. A fume concentrator for smelting furnaces including a fume chamber, a series of hollow and transversely disposed baffles projecting into the fume chamber alternately from opposite sides thereof, means for circulating a refrigerating medium through the hollow baffle members, a conduit leading from one end of the fume chamber to the furnace, reagent pipes entering the conduit for partially treating the fumes before they enter the fume chamber, a chamber communicating with the opposite end of the fume chamber, means within the said chamber for drawing the fumes positively through the conduit and fume chamber, reagent pipes entering the fume chamber at the bases of the hollow baffles upon opposite sides thereof and arranged to produce jets along the sides of the baffles so as to tend to propel the fumes through the chamber, and traps arranged at successive intervals in the length of the fume chamber at the base thereof.

2. A fume concentrator for smelting furnaces including a fume chamber, a conduit leading from one end of the fume chamber to the furnace, means for introducing reagents into the conduit to partially treat the fumes before they reach the fume chamber, a series of baffles projecting alternately from opposite sides of the fume chamber, a series of reagent pipes entering the fume chamber at the bases of the baffles upon opposite sides thereof and arranged to produce jets along the sides of the baffles, a second chamber communicating with the discharge end of the fume chamber, a series of revolving paddles mounted within the second chamber, means for dropping water upon the revolving paddles whereby the water is dashed into a spray and caused to effectively wash the fumes, means for introducing reagents into the said second chamber, and means for positively drawing the fumes through the conduit and chambers.

3. A fume concentrator for smelting furnaces including a fume chamber, a conduit leading from one end of the fume chamber to the furnace, means for introducing reagents into the conduit to partially treat the fumes before they reach the fume chamber, a series of transverse baffles projecting into the fume chamber alternately from opposite sides thereof, a series of reagent pipes entering the fume chamber at the bases of the baffles upon opposite sides thereof and arranged to produce jets along the sides of the baffles, a second chamber communicating with the discharge end of the fume chamber, paddles mounted within the second chamber, means for dropping water upon the revolving paddles whereby the same is dashed into a spray and caused to effectively wash the fumes, means for introducing reagents into the second chamber, a series of traps arranged at intervals along the bottoms of the fume chamber and second chamber, a third chamber communicating with the discharge end of the second chamber, and means within the said third chamber for positively drawing the fumes through the conduit and the various chambers.

In testimony whereof I affix my signature in presence of two witnesses.

STEPHEN W. SMITH.

Witnesses:
JAMES S. McGINNIS,
FRANK SPINELLI.