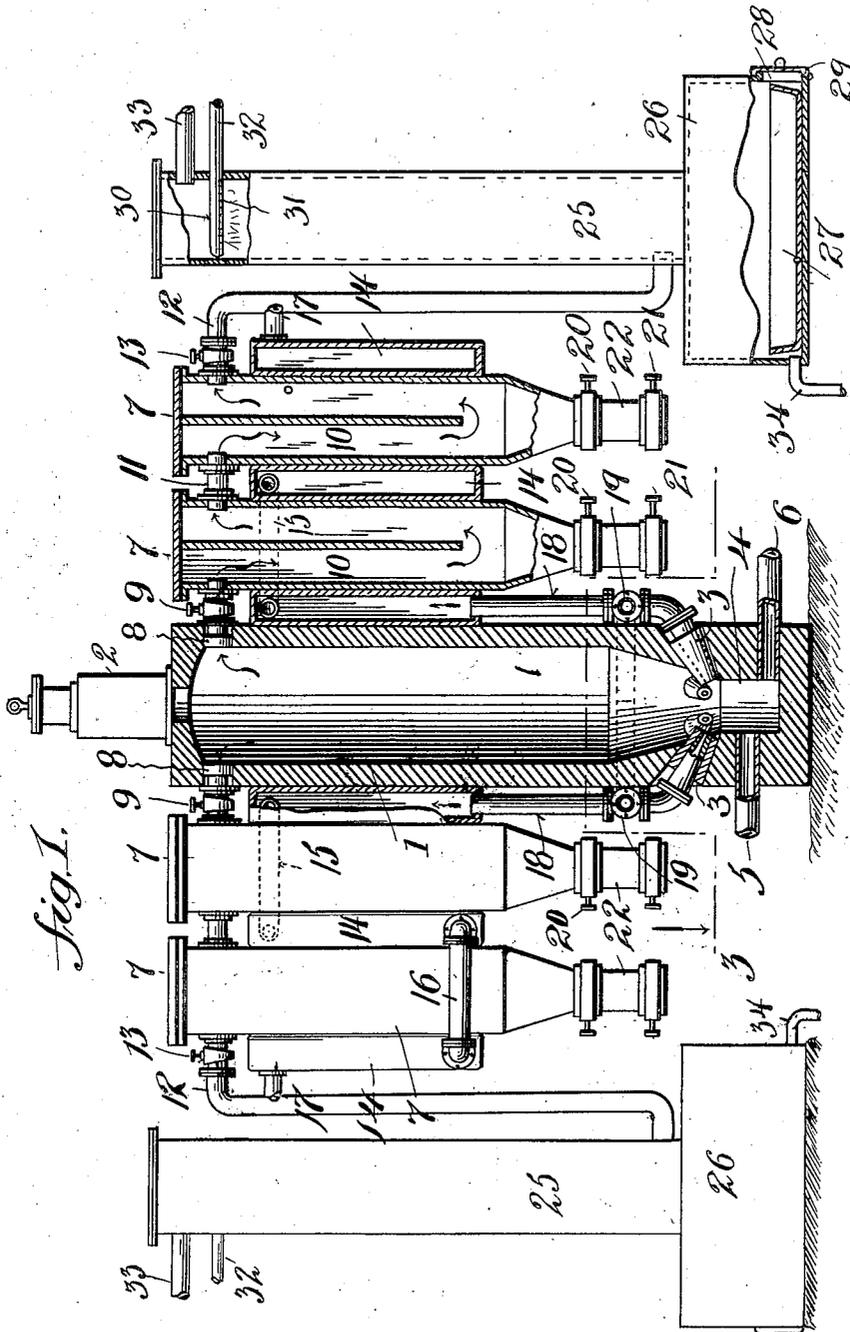


G. M. WESTMAN.

PROCESS OF REDUCING ARSENICAL ORES.

APPLICATION FILED NOV. 20, 1906. RENEWED JUNE 29, 1907.

2 SHEETS—SHEET 1.



Witnesses
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No. 879,932.

PATENTED FEB. 25, 1908.

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2 SHEETS—SHEET 2.

fig. 2.

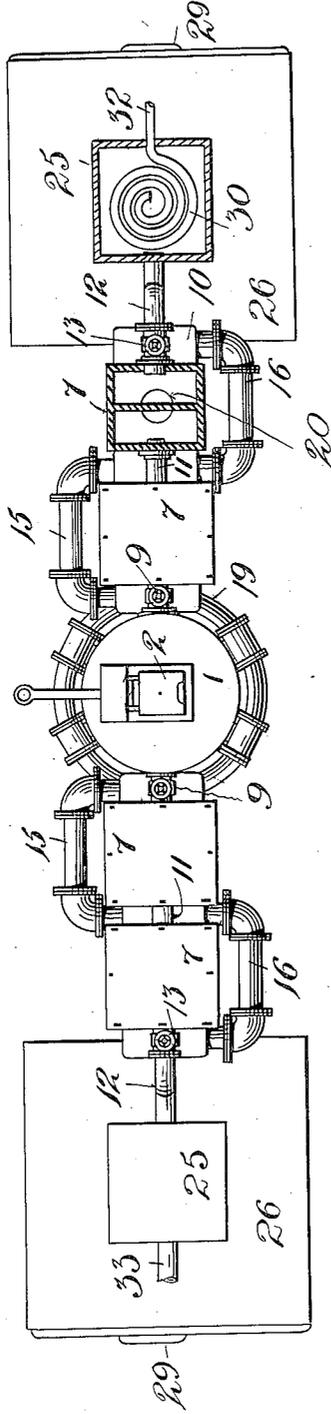
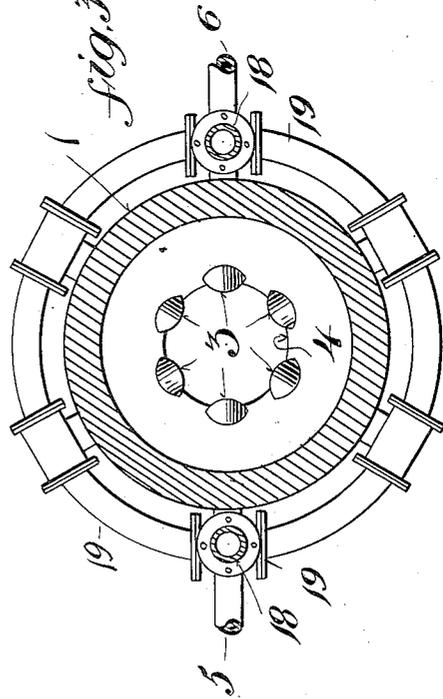


fig. 3.



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UNITED STATES PATENT OFFICE.

GUSTAF M. WESTMAN, OF NEW YORK, N. Y.

PROCESS OF REDUCING ARSENICAL ORES.

No. 879,932.

Specification of Letters Patent.

Patented Feb. 25, 1908.

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To all whom it may concern:

Be it known that I, GUSTAF M. WESTMAN, a subject of the King of Sweden, and resident of New York city, borough of Manhattan, State of New York, have invented certain new and useful Improvements in Processes of Reducing Arsenical Ores, of which the following is a specification.

My invention relates to an improved process for producing metallic arsenic from arsenical ores.

In carrying out my invention I pass air through glowing coke in a chamber containing the ores to be treated, whereby heated reductive gases containing carbon monoxid are formed that pass through and act upon the arsenical ores, and whereby said ores are retained in the presence of said gases and in more or less contact with the glowing coke for a relatively long time and the matte can trickle from one hot piece of coke to another, and so on down to the bottom of the chamber, and thereby the arsenic in the ores will be carried off in the form of arsenical vapors, and said vapors are then condensed into solid or metallic form. The matte remaining may be treated for the recovery of any of the elements therein. Condensing of the arsenical vapors may be assisted by causing air under pressure to circulate around the condensers, and such air thus heated may be forced through the chamber or furnace containing the coke and ores and thus utilized for economizing heat. The gases remaining after condensation of the arsenical vapors and production of the metallic arsenic may be discarded or used for any desired purpose. I also introduce lime or limestone in the charge of coke and ores to cause fluxing of the rock that may be in the coke or ore to form a slag which may be drawn from the lower portion of the chamber or furnace, the matte also being drawn therefrom.

I have illustrated in the accompanying drawings an apparatus whereby my improved process of producing metallic arsenic may be carried out, wherein

Figure 1 is a side elevation, partly in section, of the apparatus, Fig. 2 is a plan view thereof, and Fig. 3 is an enlarged sectional plan view of the furnace or reducing chamber.

A suitable furnace or chamber 1, adapted to contain coke and the ores to be treated, is shown provided with a suitable hopper 2

for the admission of the charges, and at the lower part of said furnace or chamber are twyers 3, entering the same for the admission of air under pressure, and at 4 is a pocket or space to receive slag and matte which may be drawn therefrom through outlets 5 and 6, the outlet 5 being shown at a higher level than the outlet 6 for the purpose of drawing the slag from above the matte. At 7 are suitable condensers for the arsenical vapors, which are shown connected at their upper parts with the upper part of chamber or furnace 1 by pipes 8 which may be provided with valves 9 for controlling the flow of the vapors. The condensers 7 are shown provided with interior partitions 10 to cause the gases to take a downward and upward course therein. Any desired number of condensers may be connected with furnace or chamber 1, and I have shown two of such condensers on opposite sides of the furnace and connected therewith, and the adjacent condensers are shown connected together by pipes 11, the outlets 12 from the condensers being shown provided with suitable valves 13.

While the condensers 7 may be cooled in any suitable manner, I have shown jackets or chambers 14 adjacent to or surrounding the condensers for the passage of air there-through, and said jackets or chambers are shown respectively connected together by pipes 15 and 16 so as to cause circulation of air through said jackets. I have shown pipes 15 connecting two associate jackets near their upper parts, and pipes 16 connecting two associate jackets near their lower parts, the air inlet pipes 17 being shown connected with the outer jackets 14 at their ends opposite the pipes 16, whereby air entering the outer jacket 14 will pass down the same, thence through pipe 16 to the lower part of the next jacket 14, thence upward therein and through pipe 15 into the upper part of the next jacket, and down within the latter and thence through the outlet pipe 18. The twyers 3 are shown connected with a pipe 19 to which the pipes 18 are also connected whereby the heated air from the jackets 14 will pass through pipes 18 and 19 to the twyers and thence into the furnace or chamber 1. The condensers 7 are shown provided at their lower parts with valves 20 and 21, whereby the valve 21 may be closed and the valve 20 opened to admit the arsenic into chamber 22, and then the

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valve 20 may be closed and valve 21 opened for the discharge of the arsenic, and the escape of vapors is thus prevented.

To further assist in condensing practically all of the arsenic carried off from the furnace in the arsenical vapors I have shown the pipes 12 leading from the condensers as entering chambers or pipes 25 that connect at the lower ends with box or receptacle 26 provided with a removable pan 27 adapted to be withdrawn through opening 28 having a water tight closure 29, and in the upper part of each chamber 25 is a pipe coil 30 provided with perforations 31 and connected with a water inlet pipe 32, whereby water in the form of spray or drops may fall from coil 30 through chamber 25 into box 26. At 33 is an outlet connected with chamber 25 for the escape of gases. When the arsenical vapors enter chamber 25 from outlet 12 the water dropping from coil 30 causes condensation of the arsenic remaining in said vapors, and the metallic arsenic will drop into the pan 27 and may be removed as required. Water flows from box 26 through a suitable outlet 34. The gases not condensed by the water will flow through outlet 33.

The air inlets 17 for the jackets 14 may be connected with any suitable blower or compressor, so that the air will be delivered under pressure from the twyers into the furnace and will be heated in its passage through the jackets while cooling the condensers.

In carrying out my improved process coke is filled into the furnace or chamber 1 and heated to incandescence in any suitable manner, and the ores to be treated are filled into the same chamber upon the coke or mixed therewith, and where rock is present in the ores I introduce a suitable quantity of lime or limestone into the furnace to cause fluxing of the rock. Air being forced through the twyers passes through the glowing coke producing heated reductive gases containing carbon monoxid, which gases act upon and pass through the arsenical ores at high temperature, thereby volatilizing the arsenic, and the arsenical vapors thus produced pass into the condensers where they are condensed into metallic arsenic which may be removed as desired through the valves 20 and 21. The arsenical ores being thus maintained in the presence of the glowing coke and of the heated reductive gases are not only subjected to the action of said gases but to the direct heat of the glowing coke for a relatively long space of time, and the matte can trickle down from one hot piece of coke to another until it passes away in the pocket below the coke, and thus the reductive gases continually act upon the ores to volatilize the arsenic therein. The lime introduced in the charge causes the rock that may be in the furnace to produce slag which may be

drawn off as required, through outlet 5, as may also matte from outlet 6. The heat absorbed by the air in jackets 14 from the condensers 7 is utilized by being forced through the twyers, thus economizing heat and assisting in producing the heated reductive gases in the furnace.

If the arsenical ores to be reduced are mispickite (FeAsS) the hot reductive gases passing through the ores will cause the arsenic to volatilize, and the arsenical vapors which pass into the condensers with the gases are condensed when the temperature of the gases sinks. No combination between the arsenic and any hydrogen that may be present can take place at the high temperature existing in the furnace.

If the ores to be treated contain FeAs_2 , as much yellow pyrites (FeS_2) must be added to the ores as required to expel the arsenic, so that when subjected to the action of the heated reductive gases the final matte will consist of simple sulfurets of iron.

Another form of ore, viz:— Ag_3As , must also be mixed with FeS_2 , before heating the same, and thus may be treated in the manner above described, by which the arsenic is expelled and partly replaced by sulfur. If nickel or cobalt be in the ores, instead of iron, the treatment will be the same as described above as where the iron is present.

I have described the use of glowing coke through which air is to be driven for producing the highly heated reductive gases containing carbon monoxid, as a convenient means for producing such gases. The process of producing metallic arsenic may thus be carried out within a closed apparatus, overcoming the danger of the escape of noxious or injurious gases, and the process can be carried on continuously and cheaply, the matte being drawn off as required and new charges supplied to the furnace, and the metallic arsenic can be removed while the process continues.

Having now described my invention what I claim is:—

1. The process of producing metallic arsenic consisting in subjecting arsenical ores to the action of heated reductive gases containing carbon monoxid, and then condensing the arsenical vapors passing from said ores.

2. The process of producing metallic arsenic consisting in passing air through glowing coke in the presence of arsenical ores, and then condensing the arsenical vapors passing from said ores.

3. The process of producing metallic arsenic consisting in passing air through glowing coke and arsenical ores in the same chamber, and then condensing the arsenical vapors passing from said ores.

4. The process of producing metallic arsenic consisting in charging coke and ar-

senical ores in a chamber, heating said coke to incandescence, passing air through said coke and ore to produce heated reductive gases and volatilize the arsenic, and then
5 condensing the arsenical vapors passing from said ores.

5. The process of producing metallic arsenic consisting in charging coke, arsenical ores and limestone or lime into a chamber,
10 heating the coke, passing air through said charge to produce heated reductive gases to expel the arsenic, and then condensing the arsenical vapors passing from said ores.

15 6. The process of treating arsenical ores consisting in mixing said ores not containing sufficient sulfur to expel all the arsenic with

yellow pyrites, subjecting said mixture to the action of heated reductive gases, and forming a matte of simple sulfuret.

7. The process of treating arsenical ores 20 consisting in mixing said ores not containing sufficient sulfur to expel all the arsenic with yellow pyrites, subjecting said mixture to the action of heated reductive gases, and forming a matte of simple sulfuret, and then 25 condensing the arsenical vapors passing from said ores.

GUSTAF M. WESTMAN.

Witnesses:

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