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APPARATUS FOR TREATING ORE

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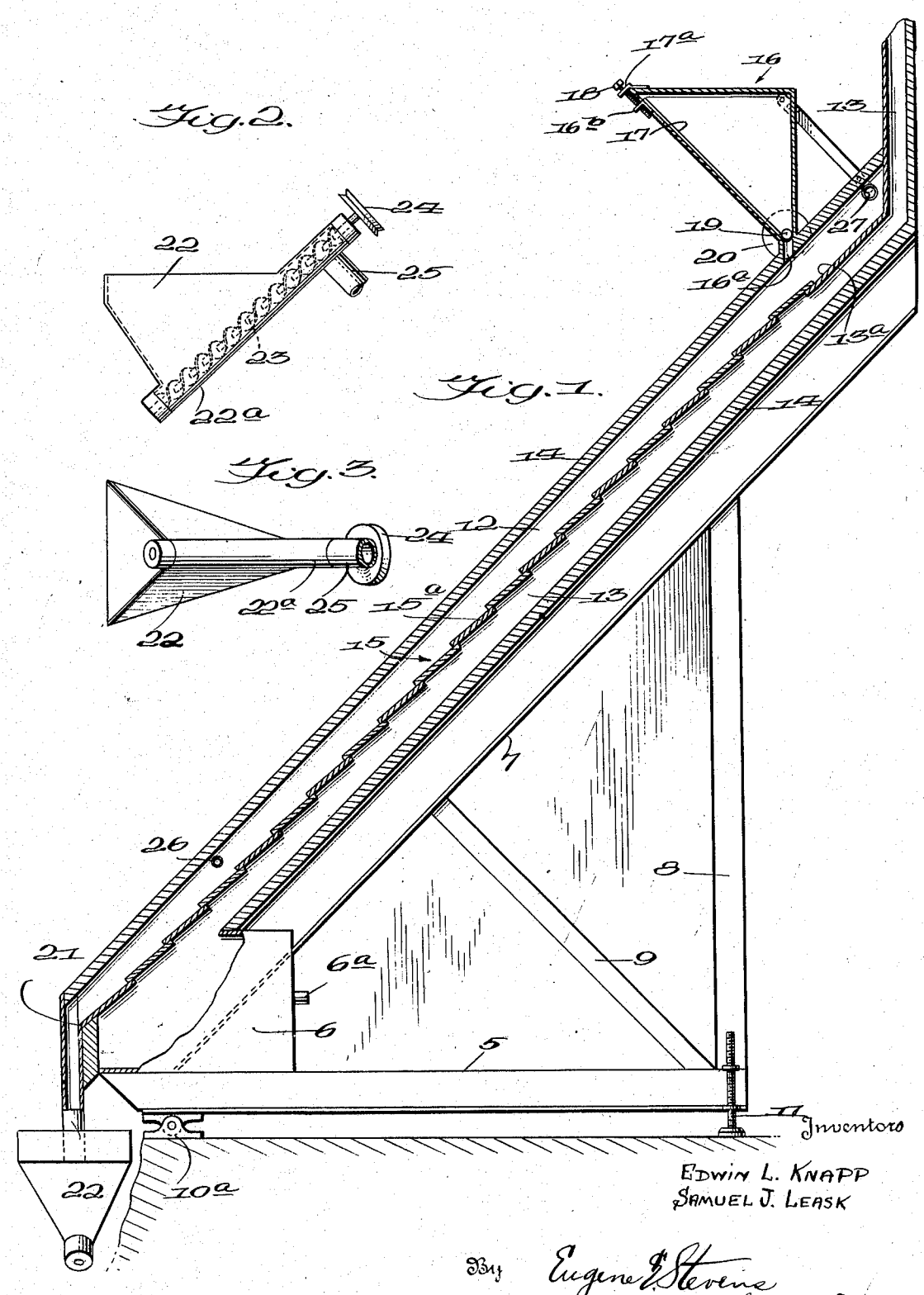


Fig. 2.

Fig. 1.

Fig. 3.

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APPARATUS FOR TREATING ORE

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Our invention relates to an improved apparatus for treating ore for the removal of its metal content, and has especial reference to the treatment of ore containing gold or other noble metals.

In accordance with standard practice it has been the custom to subject the ore to a roasting treatment for the purpose of separating therefrom the refractory products so as to leave the gold or other metal in as nearly a free state as possible. In connection with this roasting treatment various chemicals have frequently been used as a further aid in the disintegration of the ore. It has also been proposed to effect some agitation of the ore during the roasting treatment, either in conjunction with the chemical treatment or without it.

However from the point of view of efficiency the heretofore known methods and apparatus have left much to be desired. For instance the treatment has been slow, expensive, has made for considerable loss of the refractory products which are sought to be recovered, and has made necessary various other expensive treatments of the ore following the roasting treatment in order to recover the gold or other metal. Furthermore, under continuous flow processes as heretofore practiced in known apparatus, it has been impossible to control the speed of travel of the ore through the roaster so as to achieve best results considering the particular ore being treated; and additionally there has been objectionable oxidation of the gold or other noble metal due to its exposure to the atmosphere to a greater or lesser extent during the roasting treatment.

Our invention therefore has for its primary object to overcome the aforenoted objections and provide a process and apparatus of greatly enhanced efficiency, not only as to the elimination and recovery of the refractory products from the ore, but which will also save time and expense, avoid oxidation of the metal, and enable the speed of flow of the ore through the roaster to be readily controlled as occasion may require according to the particular ore being treated.

More specifically it is one of the important objects of the invention to provide a process for the treatment of ore which eliminates the necessity for subjecting the ore to treatment by chemicals during the roasting treatment as an aid to separation of the refractory products therefrom.

Another object of the invention is to provide a process for the purpose specified which includes the step of subjecting the ore to the action of live steam under pressure in a roaster, retort or the like for the purpose of separating the refractory products therefrom and/or as the vehicle for completely carrying off such refractory products so that same will not condense within the retort or roaster, and can be readily collected in suitable condensers.

Other objects and advantages of the invention will become readily apparent to those skilled in the art as the description proceeds, and reside in certain novel process steps; and in various features of construction, combination and arrangement of the various parts of the apparatus illustrated in the accompanying drawing forming a part of this specification.

As required by the patent statutes the drawing and this specification deal with what appear to be preferred examples of the inventive concept. However, it is to be understood that the invention is susceptible of other expression within the spirit and scope of the subject matter claimed hereinafter.

In the drawing,

Figure 1 is a side elevational view, partly in section illustrating a novel "continuous flow" roaster embodied in the invention;

Figure 2 is a detail view in side elevation of a fluid-receiving ore-discharge-receiving hopper associated with the roaster, and which provides a seal for the ore discharge spout thereof to prevent entry of air into the roaster;

Figure 3 is a bottom plan view of the hopper shown in Figure 2.

Referring specifically to the drawing wherein the same reference characters have been used to designate the same parts in all views, numeral 5 denotes a suitable base which preferably comprehends several laterally spaced and connected I-beams. As shown in Figure 1, the forward end of the base 5 supports the furnace 6 which may be of any suitable construction and adapted for any fuel, although as herein disclosed it is an oil burning furnace having the fuel connection shown at 6a.

In carrying out the invention, we provide at the forward or furnace carrying end of the base 5, an upwardly and rearwardly inclined frame or bed member which may comprise a plurality of laterally spaced and connected I-beams or other supports 7. This frame or bed member is rigidly supported at a predetermined angle to the base by means of upstanding posts or columns 8 at the end of the base; and by intermediate

braces such as 9, which may be secured to the base 5 adjacent the rear end of the latter, and connected to the beams 7 of the frame at points between the upper ends of posts 8 and the forward end of the base 5.

Figure 1 illustrates the forward furnace-carrying end of the base 5 as supported upon a horizontal axle or pivot 10 which is carried by ground-supported blocks or the like 10a. The rear end of the frame 5 is supported by one or more screw jacks or the like 11. Inasmuch as the forward end of the base 5 is supported for vertical pivotal movement about axle 10, it becomes at once apparent that the operation of the jack, or jacks 11, enables the inclination of the beam-provided bed 5 to be varied as the result of elevating or lowering the rear end of the base 5. This is a very important feature of the invention, as will become more clearly apparent as the description proceeds.

The upwardly and rearwardly inclined beam-provided bed 7 carries the preferably refractory casing 14 leading from the furnace 6. Casing 14 provides the medial partition 15 preferably formed of overlapping refractory slabs 15a. Such partition divides the inclined bed-supported casing lineally into an upper ore-receiving and digesting chamber 12, and a subjacent flue 13 which communicates with the furnace 6 to carry off the products of combustion. The digesting chamber, as will be understood, is heated by the hot gases from the furnace passing up the flue 13, and, as shown, the lower end of the digesting chamber 12 is directly exposed to the heat of the furnace.

The digesting chamber 12 has the ore inlet 16a adjacent the upper end of the refractory bed-carried casing 14 and the ore outlet 21 at the lower end thereof, as shown.

The ore receiving hopper 16 is suitably supported adjacent the upper end of the casing 14 to discharge its ore into the digesting chamber through the inlet 16a, and said ore feeding hopper 16 preferably provides a driven feed roll 19 in its outlet to assure a continual and even flow of ore to the digesting chamber. Control of the size of the inlet 16a into the digesting chamber 12 is effected by means of the adjustable feed plate or valve 17, it being noted that the feed roll 19 is located at one side of said inlet 16a, so as to admit of the plate 17 being actuated inwardly to fully close such inlet 16a, if desired. The feed plate or valve 17 may be controlled by means of a screw 18 rotatably carried by the bearing lug 16b of hopper 16 and taking in the threaded opening of lug 17a of plate 17. Numeral 20 designates the drive pulley of the feed roll 19, and it may derive power from any suitable source, not shown.

The lower end of the digesting chamber 12 has its outlet chute 21 discharging into the discharge hopper 22 which has a trough-like bottom 22a within which works the screw conveyor 23 for ejecting the treated ore through the outlet 25. The conveyor has a drive pulley 24 which may be driven by a belt or other source of power, not shown.

In carrying out the invention, we further provide the refractory casing 14, adjacent the furnace 6, with a steam supply pipe 26 discharging into the digesting chamber 12. The steam helps soften the ore and carries off gases and volatile constituents which pass out through the outlet pipe 27 which is located beyond the ore inlet opening 16a.

In practicing the process the ore will first be crushed in a suitable crusher, conveyed to a conventional ball or rod mill where it is ground to about eighty or a hundred mesh and discharged into a suitable conveyor which deposits the ground ore into the supply hopper 16. The foregoing being more or less standard practice and forming no part of the present invention, has not been illustrated.

Before admitting ore into the digesting chamber 12, the discharge hopper 22 will be filled with water to immerse the lower end of the ore discharge chute 21. The furnace 6 will be started and the digesting chamber 12 and its floor provided by the step-like overlapping refractory slabs heated to the proper degree, say, from about 1500° F. to 2500° F., before feed plate 17 is retracted and feed roll 19 started to discharge ore into the digesting chamber. However, before ore is admitted into the digesting chamber, and while the feed plate or valve 17 is still in position to close the digesting chamber inlet 16a, live steam under pressure of say from twenty to fifty pounds according to the weight of the refractory elements being given off will be admitted into the digesting chamber through the nozzle 26, so as to drive out the air contained in the digesting chamber through the steam or vapor outlet 27.

When the feed plate or valve 17 is retracted by means of the control screws 18, feed roll 19 discharges ore into the digesting chamber 12 and the ore cascades down the inclined series of steps provided by the heated refractory slabs 15a toward the discharge chute 21. As pointed out hereinbefore, the speed of travel of the crushed ore toward the outlet chute 21 is governed by the inclination of the series of refractory slabs 15a; and such inclination can be varied by adjustment of the jacks 11 to raise or lower the rear end of the base 5 about the horizontal axle or front end support 10. Different ore requires different lengths of treatment. Inasmuch as we are able to vary the incline of the series of slag steps 15a, we are able to obtain adequate treatment of different ores in a continuous flow digester, such as is illustrated in Figure 1.

The live steam admitted into the digesting chamber through the nozzle 26, not only cooperates with the furnace-supplied heat from slabs 15a in separating the refractory products from the ore, but also serves as the vehicle for gathering up and completely removing such refractory products from the digesting chamber 12 through the steam and vapor outlet 27 which leads to suitable condensers (not shown) for the recovery of such products.

An important point to bear in mind is that inasmuch as the discharge chute 21 is immersed in the water of discharge hopper 22 and the supply hopper 16 is kept supplied with ore, it will be impossible for air to find its way into the digesting chamber. Noble metals such as gold are not disintegrated by heat but they will oxidize when heated and cooled in the atmosphere. The elimination and exclusion of air from the digesting chamber 12 is therefore a highly important item.

While various efforts have been made in the past to carry off the refractory products from a roasting chamber by the use of steam vapor as contradistinguished from live steam, such practice has resulted in condensation of such refractory products and their steam vapor vehicle before same have passed from the roasting chamber. Naturally, this has resulted in loss of re-

fractory products and a general decrease in the efficiency of the treatment as heretofore practiced. Furthermore, the helpful disintegrating action upon the ore by live steam has apparently not been appreciated by those who have preceded us in this art.

By the time the ore reaches the discharge chute **21**, it is in a free milling state and substantially free from refractory elements. Such treated ore having been discharged into the hopper **22** is removed therefrom by means of the driven conveyor **23** from which it may be conducted to a centrifugalizer or amalgamator for final treatment to extract the metal as usual.

In contradistinction to the continuous flow process, as hereinabove described, the ore may be suitably crushed and ground and deposited in a retort, there to be acted upon by live steam, the retort having first been heated to a predetermined degree. The sulphur, arsenic, and other refractory elements of the ore to be carried from the retort by the live steam and recovered by means of suitable condensers, as before.

Having thus described our invention, what we claim as new is:

1. Ore treating apparatus comprising a base, a furnace carried thereby, an upwardly extending inclined casing fixedly carried by said base, said casing providing an ore-digesting chamber having an ore inlet adjacent its upper end and an outlet adjacent its lower end, a flue in said casing subjacent to said digesting chamber for heating the latter, said flue having its lower end communicating with the furnace and its upper end communicating with the atmosphere, a refractory partition separating said flue and digesting chamber and forming a top wall of the furnace, and means for varying the inclination of said base.

2. Ore treating apparatus comprising a base, a furnace fixedly carried thereby, an upwardly extending inclined casing fixedly carried by said base, said casing providing an ore-digesting chamber having an ore inlet adjacent its upper end and an outlet adjacent its lower end, a flue in said casing subjacent to said digesting chamber for heating the latter, said flue having its lower end communicating with the furnace and its upper end communicating with the atmosphere, a refractory partition separating said flue and digesting chamber with its lower end constituting a top wall of the furnace, a spout extending from said digesting chamber outlet downwardly along a wall of the furnace, a water containing vessel immersing the outer end of said spout, and an ore supply hopper adjacent said digesting chamber inlet in a manner to cause its contents to substantially seal the same against the entry of air, and means for varying the inclination of said base.

3. Ore treating apparatus comprising a base, a furnace carried thereby, an upwardly extending inclined casing carried by said base, said casing providing an ore-digesting chamber having an ore inlet adjacent its upper end and an outlet adjacent its lower end, a flue in said casing subjacent to said digesting chamber for heating the latter, said flue having its lower end communicating with the furnace and its upper end communicating with the atmosphere, a refractory partition separating said flue and digesting chamber, a spout extending from said digesting chamber outlet, a water containing vessel immersing the outer end of said spout, an ore supply hopper adjacent said digesting chamber inlet in a manner to cause its contents to substantially seal the same against the entry of air, means for varying the inclination of said casing, a live steam supply means opening into said digesting chamber adjacent its lower end, and an outlet for the refractory product-laden steam adjacent the upper end of said chamber.

4. Ore treating apparatus comprising a base, a furnace fixedly carried thereby, an upwardly extending inclined casing fixedly carried by said base, said casing providing an ore-digesting chamber having an ore inlet adjacent its upper end and an outlet adjacent its lower end, a flue in said casing subjacent to said digesting chamber for heating the latter, said flue having its lower end communicating with the furnace, and its upper end communicating with the atmosphere, a refractory partition separating said flue and digesting chamber, means supporting one end of said base for vertical pivoting movement, and vertically adjustable supports for the opposite end of said base whereby the inclination of said casing can be varied to control the speed of flow of the ore through the digesting chamber.

5. Ore treating apparatus comprising a base, a furnace carried thereby, an upwardly extending inclined casing carried by said base, said casing providing an ore digesting chamber having an ore inlet adjacent its upper end and an ore outlet adjacent its lower end, a flue intake casing subjacent to said digesting chamber for heating the latter, said flue having its lower end communicating with the furnace and its upper end communicating with the atmosphere, a refractory partition separating said flue and digesting chamber and extending into and forming the top wall of the furnace, a steam inlet pipe extending laterally through a wall of the casing into the ore digesting chamber at its lower end directly above that portion of the partition providing the top wall of the furnace, and a steam outlet pipe extending laterally through a wall of the casing at the extreme upper end of the digesting chamber.

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