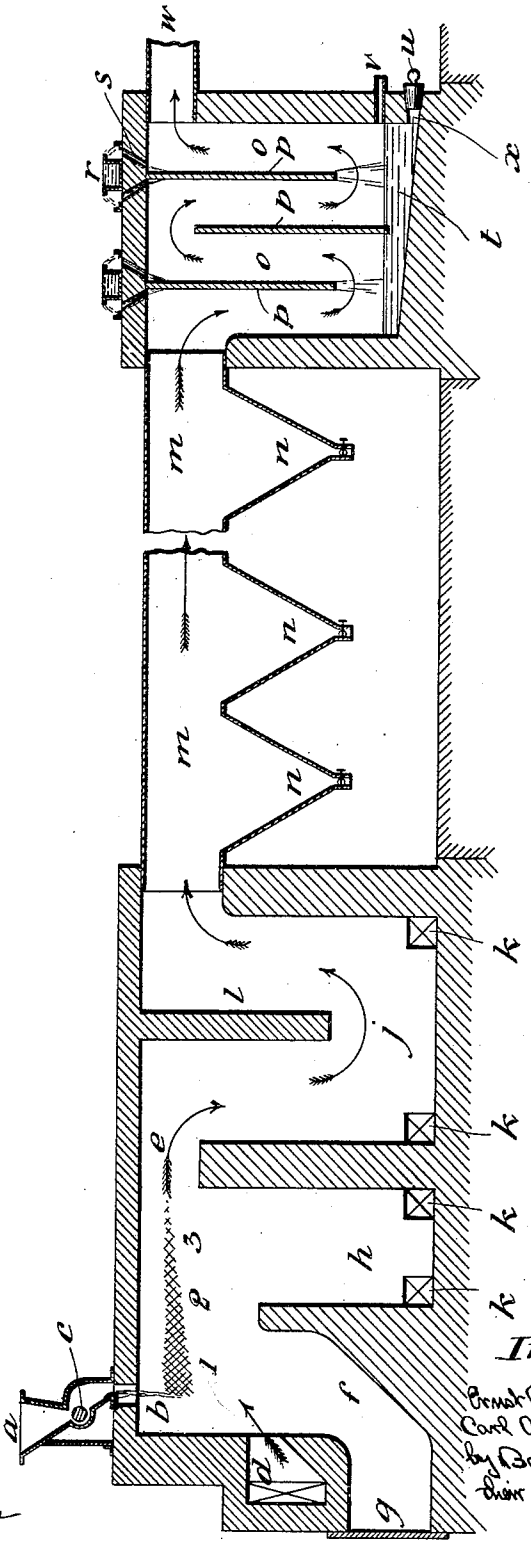
No. 677,263. Patented June 25, 1901.

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## PROCESS OF ROASTING MIXED SULFID ORES.

(Application filed July 18, 1899.)

(No Model.)




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# UNITED STATES PATENT OFFICE.

ERNST CHRISTIAN HERMANN PAPE AND CARL AUGUST LOUIS WILHELM WITTER, OF HAMBURG, GERMANY.

## PROCESS OF ROASTING MIXED SULFID ORES.

SPECIFICATION forming part of Letters Patent No. 677,263, dated June 25, 1901.

Application filed July 18, 1899. Serial No. 724,230. (No specimens.)

*To all whom it may concern:*

Be it known that we, ERNST CHRISTIAN HERMANN PAPE, residing at Hohe Bleichen 36 II, and CARL AUGUST LOUIS WILHELM WITTER, residing at Hühnerposten 10, Hamburg, Germany, citizens of Germany, have invented a certain new and useful Improved Process of Winning Metals from Ores Containing Themas Sulfids, (for which we have applied for a patent in Germany, dated June 12, 1899, and in Great Britain, dated June 15, 1899, No. 12,512,) of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming part of this specification, in which the figure is a vertical section showing one form of apparatus for carrying out our invention.

Our invention relates to an improved process of winning from their sulfid ores metals which are volatile at a temperature at which they cannot oxidize. The process depends on the fact that when a metal is introduced into oxygen and is heated to a certain temperature the metal and oxygen remain disunited until the temperature is allowed to fall. If the metal is volatile at the temperature, it may be caused to pass away as vapor from the place of high temperature and to cool to a point at which it can combine with oxygen to form again the oxid. Thus it happens that some metallic oxids which are not volatile as such at any practicable temperature nevertheless appear to volatilize in a current of air if the temperature is above that at which the metal can combine with oxygen and at which the metal volatilizes. It is obvious that for the realization of the apparent volatilization of the oxid it is not necessary to start with the oxid. Thus if zinc sulfid is introduced into oxygen which is at a temperature above that at which zinc and oxygen can combine the sulfur of the sulfid will oxidize, but not the zinc, which will remain as zinc-vapor mixed with the oxygen until the mixture is cooled.

According to this invention the foregoing principle is put into practice as follows: A combustion-chamber is first heated to a high temperature by burning fuel in it, and there is introduced into it a current of previously-heated air. Into this chamber is fed the ore to be roasted in a finely-divided state at a point where it must pass through the current of hot air. The temperature of the ore immediately attains the ignition-point of the sulfids contained therein, and the combustion of these raises and maintains the temperatures above that at which the zinc, lead, and silver can combine with oxygen. As is known, the combustion of the sulfids converts them into oxids, except a small part, which become sulfates. The latter, together with the non-volatile constituents of the ore and those oxids which are non-volatile and not dissociated or being dissociated do no not yield volatile metals, fall to the bed of the furnace-chamber. These are iron oxid, copper oxid, and much of the lead oxid. The sulfid of zinc and much of the sulfids of lead and silver are burned as they arrive at the point where the temperature is highest, so that these metals cannot become oxids, this temperature being above the temperature at which these metals can oxidize. The metals, however, are volatile at this temperature, so they are carried forward by the current of air to a cooler part of the chamber. Here they combine with oxygen from the air to form oxids which are not volatile at the temperature of this part, and therefore settle as solids to the bottom of the chamber.

The temperature of the zone of combustion of the sulfids must be kept above the aforesaid temperature at which the metals to be won can combine with oxygen, and if the ore does not contain sufficient sulfur for this purpose fuel must be introduced, together with the ore, or the current of air must be heated separately or enriched in oxygen.

Various forms of apparatus for operating as described may be employed. The accompanying drawing is a vertical section of one form given by way of example.

In the apparatus shown in the accompanying drawing, *a* is a hopper from which the finely-divided ore descends in broad thin streams *b*, being fed by the roller *c*, revolving in bearings in the ends of the hopper. A current of heated air is supplied from the flue *d* and is directed upon the streams of ore to deflect it toward the outlet *e*.

The preliminary heating of the furnace to a temperature high enough to insure the

ignition of the sulfids or sulfids and fuel, when these are first fed in, is effected by feeding powdered fuel alone through the hopper, igniting this by burning brushwood introduced through the doors *g*, and directing a blast of air through the flues *d*.

1 indicates the zone of combustion of the sulfids, 2 the zone of dissociation temperature, and 3 the zone of oxidation of the metal vapors. The non-volatile constituents of the ore and the oxids of copper, iron, &c., fall on the sloping floor *f*, whence they can from time to time be removed by opening the door *g*. Some of the oxids which are carried forward fall into the masonry chambers *h* and *i*, whence they may be removed by opening the doors *k*. By the time the mixture of gas and vapor has passed the baffle *l* it will be cool enough to enter the iron pipes *m*, provided with dust-collecting hoppers *n n*, in which the more volatile oxids are deposited. To remove the last traces of fumes from the gases, these are next passed through the wet purifier *c*, which is a chamber provided with baffle-plates *p*. Down such of these plates as meet the roof of the chamber a solution of zinc sulfate is caused to flow from cisterns *r* through pipes *s*. In this manner the fumes are washed out of the gas and deposited as sludge at the bottom of the sump *t*, whence the sludge may be withdrawn through the opening *x*, normally closed by the plug *u*. The pipe *v* is an overflow-pipe. The purified gases pass away through the flue *w*.

Changes may be made by those skilled in the art without departure from our invention as defined in the claim.

We are aware that it has been proposed to feed powdered-sulfid ores into a hot furnace traversed by a blast of air; but the object of this proceeding is to produce a separation of the oxidized constituents of the ore, depending on differences in the volatility of the oxids and in their specific gravity. Our invention is widely different from these former methods, inasmuch as it depends on the production at one point of the furnace of a temperature so high that zinc oxid, which will not volatilize at any practicable temperature, cannot be formed, so that zinc-vapor passes forward in the current of air. If the temperature is high enough for this, much of the lead and silver in the ore will behave like the zinc.

We claim—

The process of treating sulfid ores containing metals which are volatile at a temperature at which they cannot combine with oxygen, which process consists in heating a combustion-chamber to a temperature necessary to ignite the sulfids in the ore, introducing a heated current of air in the said chamber, then feeding the finely-divided ore into the chamber so that it passes through the current of heated air, maintaining the temperature above that at which a part of the metals can combine with oxygen, allowing the metallic vapors carried forward to combine with oxygen, and then collecting the matters so carried forward; substantially as described.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

ERNST CHRISTIAN HERMANN PAPE.
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Witnesses:
E. H. L. MUMMENHOFF,
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