No. 721,311. PATENTED FEB. 24, 1903.

E. KNUDSEN.

PROCESS OF SMELTING.

APPLICATION FILED OCT. 7, 1901.

NO MODEL.

Fig. 1.

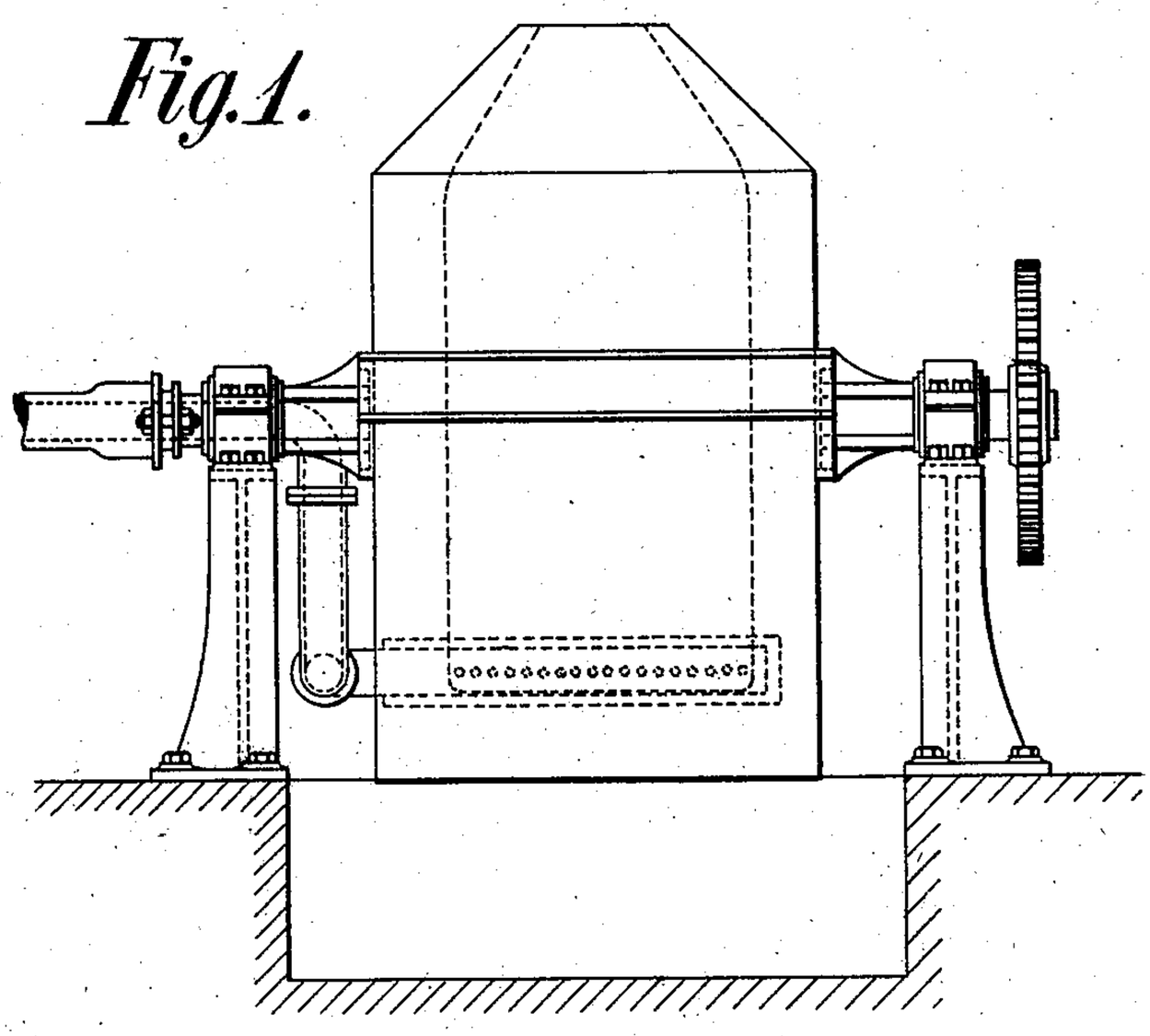
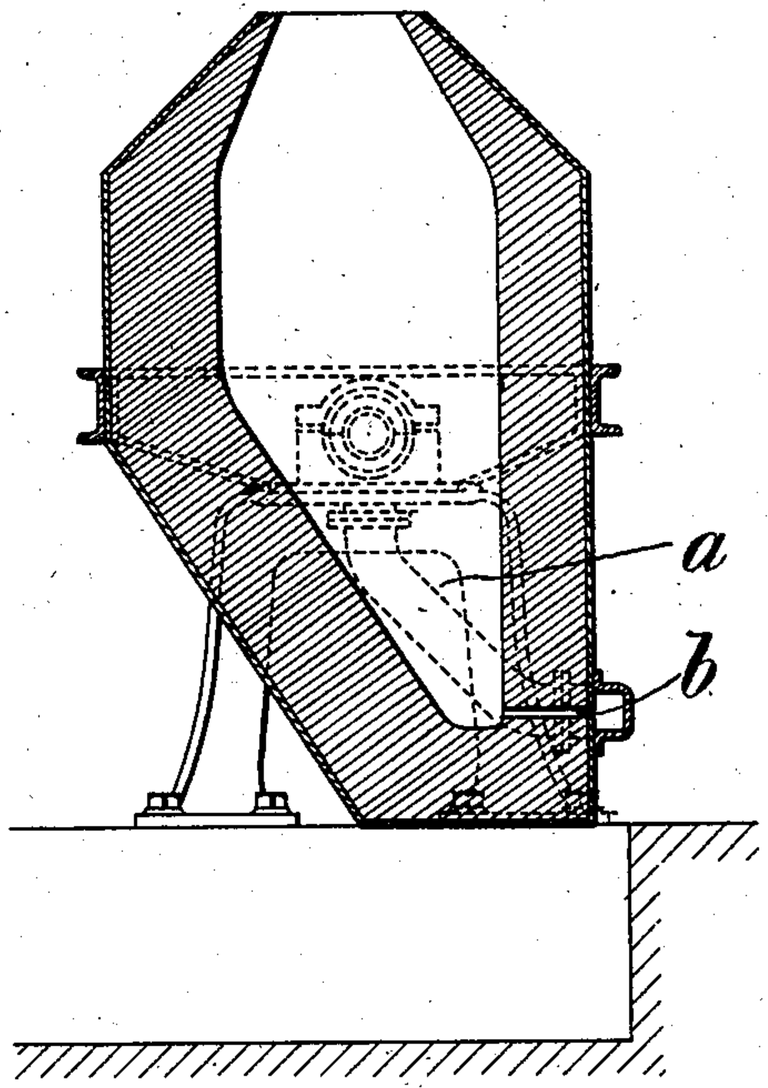


Fig. 2.



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UNITED STATES PATENT OFFICE.

EMIL KNUDSEN, OF SULITJELMA, NORWAY.

PROCESS OF SMELTING.

SPECIFICATION forming part of Letters Patent No. 721,311, dated February 24, 1903.

Application filed October 7, 1901. Serial No. 77,844. (No model.)

To all whom it may concern:

Be it known that I, EMIL KNUDSEN, a subject of the King of Sweden and Norway, residing at Sulitjelma, Norway, have invented certain new and useful Improvements in Processes of Smelting and Concentrating Unroasted Sulfid Ores and Apparatus Therefor; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

My invention relates to a process of smelting pyrites or sulfid ores and concentrating the molten charge by oxidation up to sixty to eighty per cent. (or in the case of copper even to pure metal) by one single process and substantially without the use of fuel, a sufficient amount of heat being generated by combustion of the sulfur contained in the ore to obtain the result in view by simply blowing in a blast of cold air under suitable pressure. In the place of the time and fuel wasting roasting processes now in use and of the subsequent smelting processes, whereby coarse metal and white-metal are obtained, this invention substitutes one single and simple process, wherein the use of fuel when seen apart from what is required for starting the process may be practically done away with.

In carrying this process into practice I heat a furnace, which may preferably be given the form of a converter, until its lining becomes bright yellow or white-hot throughout and thereupon deposit adjacent to the blast-nozzles a minor quantity of coke, (twenty-five to thirty kilograms, or a somewhat greater quantity in the case of ores that are more difficult of ignition.) When this coke has become red-hot, I charge the furnace with raw and unmelted ore and start the blowing-machine, so as to apply the air-blast under a pressure of from 0.15 to 0.25 kilograms per square centimeter. The ore should be previously crushed so that the largest pieces do not exceed the size of a big walnut or a hen's egg. The blast is maintained on this pressure until it can be seen from the flame appearing at the top of the furnace that the fusion of the ore has commenced, which may also be ascertained by inspecting the iron stick which is used to keep open the air-nozzles. When the greater part of the charge has been brought to a molten state, which will in most cases occur after some fifteen to twenty minutes, I increase the air-blast pressure to 0.3 or 0.4 kilograms per square centimeter and maintain the blast at this pressure until the flame emerging at the top of the furnace indicates that the concentrating process is at a sufficiently-advanced stage. Regulus of copper containing sixty-five per cent. of copper will impart to the flame a sky-blue color, at seventy-four per cent. the flame will be blue with a greenish tinge, while at lower percentages of copper the flame will assume a brighter and more yellowish color. When the process is accomplished and the furnace discharged, its lining will be bright or in part even white-hot, and the fusion of a new charge may be brought about by simply charging the furnace once more. It has been found in practice that twenty successive charges or thereabove may be smelted down without causing considerable wear to the lining and without renewal of the same. Part of the original supply of coke will in general subsist after the fusion of each successive charge. If this be not the case, an additional quantity of coke may, if necessary, be supplied and heated to a red-hot heat before recharging the furnace.

Considering now the general arrangement of the furnace, it is important that the air-blast nozzles should be situated at its lowest point and that the furnace should have its diameter gradually increasing from this point in order to realize a uniform distribution of the air and cause the ore first brought into a smolten state to collect just opposite to the air-blast nozzles. This arrangement offers the advantage of forcing the air to pass at once through molten ore, which will support the oxidizing action, and consequently promote the evolution of heat.

It will be seen that the process falls in two parts or steps—viz., the fusion of the sulfids and the concentration of the molten charge. In order to satisfactorily accomplish the latter operation, it is necessary to thus intensify the oxidizing action in the sulfids as to give to both a perfectly thin fluid consistency.

Under these conditions a separation will after the lapse of some time take place between the concentrated metal which collects at the bottom and the slag which remains floating on the surface. A suitable proportion must accordingly exist between the sulfur and silicic acid contained in the ore. In the operations hitherto performed the proportion of silicic acid in the charge amounted to twenty-three per cent., while sulfur was present in a proportion of twenty-eight per cent.

In practice I prefer, as stated, to use a converter or a similar type of furnace.

In the accompanying drawings I have shown in Figure 1 an elevation, and in Fig. 2 a vertical section, of a preferred form of converter provided with a tapering bottom portion *a* and having the blast-nozzles *b* arranged along the bottom thereof. When working with a converter of this construction, part of the slag may in the course of the process—for instance, after the lapse of an hour—be drawn off by turning the converter on its pivots. When the fusion is complete, I first draw off the slag and then pour out the molten metal.

The gases which escape during the process contain various oxids of sulfur and may be intercepted for utilization as by-products.

In the performance of my process it is not necessary to use a hot-air blast, and a cold blast may be employed. The lining of the furnace is raised to such a high temperature that the heat given off therefrom to the material in immediate contact therefrom is sufficient to start the process when the air-blast is directed into the furnace with a relatively low pressure. The air will strike along the glowing lining, and in the course of a few minutes the smelting and combustion will have commenced. In the preferred construction illustrated the furnace is narrow at the bottom, so that there will be a zone extending some distance upward, where the heat radiated from the lining will be great relatively to the quantity of raw material, and consequently only a very few minutes are required to start the process.

It will be understood that the furnace is completely emptied after each melting, so that no part of the molten material remains in the furnace from one smelting to another. Were any of the material so left in the furnace, it would be necessary to use a hot blast. Furthermore, the molten material left in the furnace would be deprived of practically all its combustible matter and would be unfit to start a new combustion.

My process effects a great economy of fuel and may be carried on in localities where fuel is difficult to obtain. It is possible to perform the process without the use of any fuel after the lining of the furnace has been raised to the desired temperature.

I claim—

1. The method of treating ores, which consists in first imparting to the lining of the furnace a high degree of temperature, then introducing to the furnace the full charge of ore, then admitting a cold-air blast to the charge at a low pressure thereby initiating the smelting of the charge and subsequently increasing the pressure of the blast causing thus the smelting and concentration of the charge without the addition of carboniferous fuel.

2. The method of smelting ores which consists in charging the ore into a furnace having a highly-heated lining, introducing an air-blast at the bottom of the furnace and below the surface of the oré, thus utilizing the sulfur in the melted ore as fuel, emptying the furnace and recharging the same with ore while the lining retains the heat imparted thereto by a previous smelting operation.

3. The process of smelting pyrites or sulfid ores which consists in charging the same into a furnace having its interior lining previously heated to a sufficiently high degree to fuse the ore, injecting a cold blast into the furnace-body and thence through the melted ore, whereby the sulfur in the ore will be oxidized and the resulting heat utilized to smelt the charge without other fuel, then emptying the furnace and recharging while the lining retains the heat imparted thereto by the previous smelting operation.

In witness whereof I have hereunto set my hand in presence of two witnesses.

EMIL KNUDSEN.

Witnesses:
SVERRE BERG,
CHR. SÆTHER.