Jan. 2, 1923. 1,440,533.

C. G. FINK.

APPARATUS FOR ROASTING ORES.

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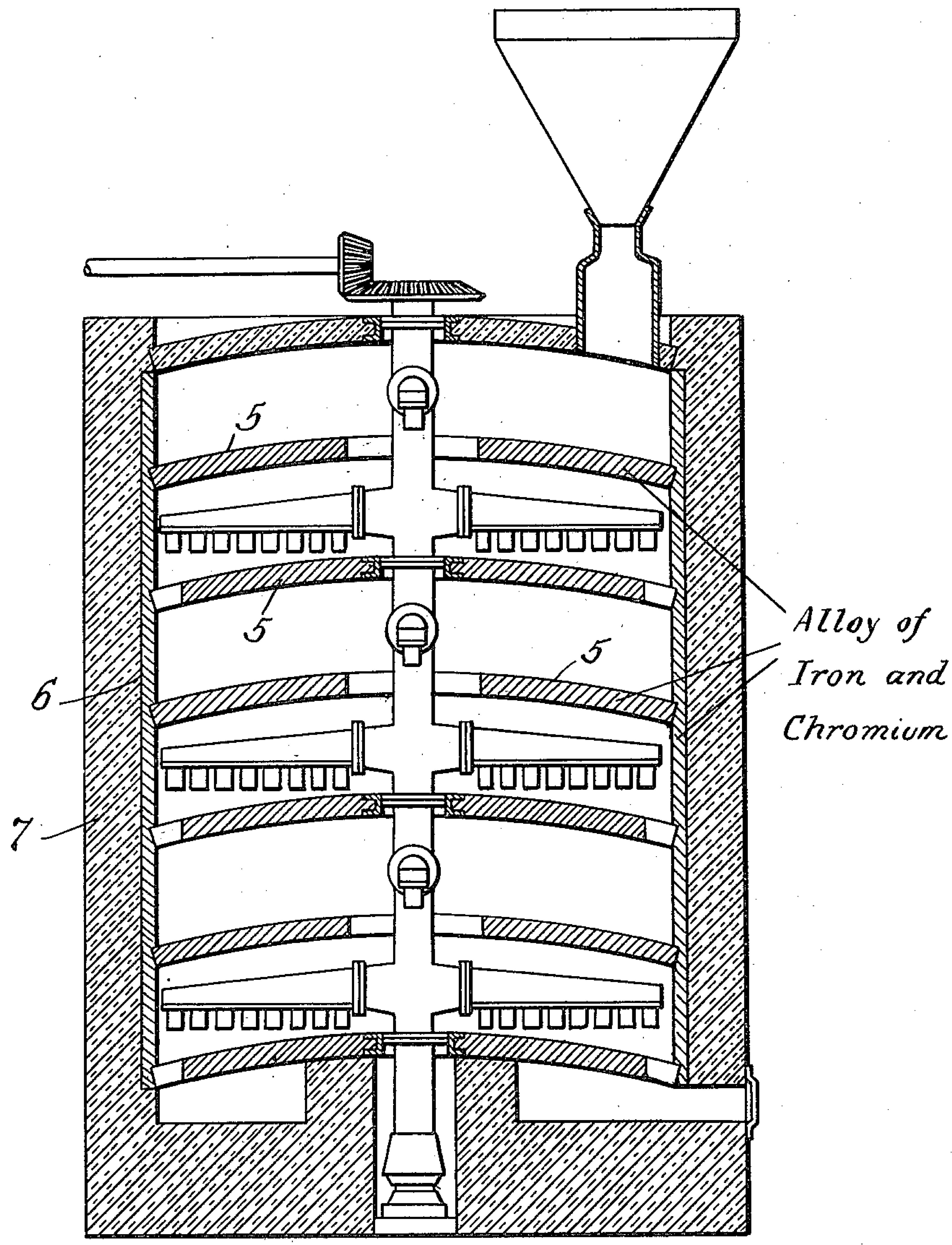

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR ROASTING ORES.

Application filed February 18, 1921. Serial No. 446,071.

To all whom it may concern:

Be it known that I, Colin G. Fink, a citizen of the United States, residing at Yonkers, in the county of Westchester, State of New York, have invented certain new and useful Improvements in Apparatus for Roasting Ores; 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.

This invention relates to apparatus for roasting ores and has for its object the provision of certain improvements in such apparatus.

Many different types of furnaces are in common use today for roasting ores. To some extent, the type of furnace employed is determined by the nature of the ore to be roasted. Thus, in roasting blend (sulfide of zinc), it is common practice to employ furnaces of the well known Matthiessen and Hegeler type. Blend is also commonly roasted in furnaces of the well known Herreshoff type, which type of furnace is likewise frequently employed in roasting copper and tin ores. Speaking generally, ore roasting apparatus may conveniently be divided into three general types of classes, (1) reverberatory furnaces, (2) muffle furnaces, (3) kilns. All of these furnaces have a hearth or bed for holding the ore during the roasting operation and appropriate instrumentalities are usually provided for working or rabbling the ore during roasting, and, in most furnaces, for progressively moving the ore along the hearth or bed of the furnace.

At the present time, it is the usual practice to construct the hearth or bed of roasting furnaces of refractory material, such as magnesite, silica, alumina, etc. Such refractory materials have poor heat conductivity and, where the heat for roasting must be transferred through a refractory wall or conveyed by conduction through such a wall, the heating efficiency is relatively low. Thus, in muffle furnaces where the heat for roasting is, to some extent at least, conveyed to the charge through the walls of the muffle, the poor heat conductivity of the refractory material of which the muffle is customarily made results in a low heat efficiency. Similarly, in roasting furnaces of the multiple-stage type, the poor heat conductivity of the superposed hearths and walls of the furnace (when made of refractory material) prevents any satisfactory transfer and distribution of heat through the furnace by heat conduction. Even in the roasting of ores (more particularly sulphide ores) which require no external heat, it is highly desirable to transfer heat from the inherently hotter to the inherently cooler parts of the furnace. Where such parts of the furnace as might effect such a transfer of heat by conduction are made of refractory material, the poor heat conductivity of the refractory material presents a formidable obstacle to the attainment of the desired result.

The present invention contemplates the provision of an improved ore roasting apparatus in which such furnace walls as are exposed to the roasting temperatures and which contribute by conduction to the distribution of heat through the furnace are made of an alloy composed chiefly of iron and chromium. Thus, the invention involves the provision of an ore roasting furnace having a hearth or bed made of an alloy composed chiefly of iron and chromium. The iron-chromium alloy is a metallic material possessing excellent heat conductivity, and by the practice of the invention greatly increased heat economy and heat efficiency are attained, as compared with furnaces in which the corresponding parts are constructed of refractory material.

In the accompanying drawing, I have illustrated merely for purposes of explanation a multiple stage roasting furnace of a well known type. This furnace comprises a plurality of superposed hearths 5 which, in accordance with the present invention are made of an alloy of iron and chromium. If desired, the side walls 6 of the roasting chambers may also be lined with the alloy of iron and chromium, but in order to prevent undue radiation of heat the main furnace structure 7 should be made of fire brick or other appropriate heat-insulating material.

As a result of my researches and investigations, I have found that the alloy of iron and chromium in order to fulfill satisfactorily the purposes of the present invention should contain not less than 30% of chromium. Thus, when the chromium content of the iron-chromium alloy is below about 30%, I find that there is an appreciable erosion or wearing away of the alloy, similar to that which takes place if ordinary iron were employed under similar conditions. In most instances, I find that the optimum results are secured when the iron-chromium alloy contains from about 33% to about 36% of chromium. Higher percentages of chromium increase the resistance of the alloy to erosion, but at the same time such higher amounts of chromium render the alloy brittle and increase its cost, so that for most practical purposes, the iron-chromium alloy should not contain over about 36% of chromium. I have, however, secured satisfactory results for the purposes of the invention with alloys of iron and chromium containing up to 60% of chromium.

In carrying out the invention, the furnace hearth, bed, wall, muffle or the like, is fabricated in any suitable manner of an iron-chromium alloy of the composition hereinbefore described. For example, the hearth, or the like, may be made by casting in sand molds, or may be made up of one or more appropriately shaped castings of an iron and chromium alloy.

In addition to iron and chromium, the alloy may, and usually will, contain carbon (one percent more or less), silicon (a fraction of one percent), and other innocuous impurities. An excessive amount of carbon in the alloy should be avoided since when present in excess carbon reduces the mechanical strength of the alloy. The alloy may also contain, in small amount, other alloying metal or metals.

The alloy composed chiefly of iron and chromium may be made by various methods. I have found it entirely satisfactory to first melt, in a magnesite-lined crucible of an electric arc furnace, an appropriate amount of iron in the form of scrap iron, pig iron, or other cheap form of iron, and then add to the molten iron commercial ferro-chromium of relatively high chromium percentage in sufficient amount to produce the desired chromium content in the resulting alloy. For this purpose, ferro-chromium containing 60% chromium may be satisfactorily used. The ferro-chromium may, moreover, be of a low grade containing as high as 8% of carbon without objectionably increasing the carbon content of the resulting iron-chromium alloy. When forming the iron-chromium alloy in an electric arc furnace, I find it desirable to maintain a covering of green oxide of chromium (Cr_2O_3) on the charge in the crucible, in order to avoid or counteract excessive absorption of carbon by the iron-chromium alloy from the carbon arc. If desired, the iron-chromium alloy may be made direct from chromite by reduction in an electric furnace with coke or anthracite coal. If the resulting alloy of iron and chromium is too low in iron, scrap iron may be added to bring the iron content up to the desired percentage.

Ordinary iron is a good heat conductor, but it will not stand up under the corroding action of the combustion gases and sulfur fumes encountered in ore roasting. On the contrary, I have found that an alloy of iron and chromium, of the composition contemplated by the present invention, resists remarkably well the action of combustion gases and sulfur fumes. In practice, I have found when roasting sulfide ores, such as blend, and chalcopyrites, that the sulfur fumes do not corrode the iron-chromium hearth of the furnace to an objectionable extent.

In an ore roasting furnace having its hearth or bed made of an alloy of iron and chromium, there is a pronounced economy in heat (compared with a similar furnace having a hearth of refractory material such as magnesite) since the heat of the combustion gases is rapidly transmitted by and through the metallic hearth. Again, an iron-chromium hearth presents a hard, smooth, wear-resisting surface which permits the passage of the rakes through the ore charge at constant depth. The life of an iron-chromium hearth is practically indefinite as compared with iron or refractory hearths. Moreover, with an iron-chromium hearth, there is no deterioration during suspension of the roasting operation, whereas a refractory hearth, under like circumstances, would crack badly. A smaller space is also required in the case of hearths, beds, etc., of iron-chromium, as compared with similar parts when made of refractory material such as magnesite. A furnace hearth made of the iron chromium alloy has the further advantage that it does not react or combine with either the metal or gangue constituents of the ore which is undergoing roasting.

An alloy of iron and chromium of the composition contemplated by the present invention, has a comparatively low coefficient of heat expansion, about one-half that of copper. This means that on heating or cooling a hearth made of an alloy of iron and chromium, no special allowance need be made for expansion and contraction. By the practice of the invention, using a hearth of an iron-chromium alloy distortion or fracture of hearths and arches, as well as heat losses, due to poor hearth and arch construction, are in a very large measure eliminated.

Perhaps the most important advantage resulting from the practice of the present invention in ore roasting apparatus resides in the greatly improved heat economy and efficiency. Thus, the iron-chromium hearth serves by its good heat conductivity to distribute by conduction heat from the hotter to the cooler portions of the furnace or ore roasting chamber.

While I have hereinbefore particularly discussed the advantages arising from the use of iron-chromium hearths in ore roasting apparatus, it is to be understood that the invention contemplates the construction of other walls of the apparatus of an alloy of iron and chromium. Thus, in its broader aspect, the invention involves constructing such walls of the ore-roasting apparatus as are exposed to the roasting temperatures and which at the same time contribute by conduction to the distribution of heat through the furnace of the iron-chromium alloy. Thus substantially the entire furnace (with the exception of the outer shell and the insulating brick lining of the same) may advantageously be made of an alloy composed chiefly of iron and chromium of the composition hereinbefore disclosed.

I claim:—

1. An apparatus for roasting ores having such walls thereof as are exposed to the roasting temperatures and which contribute by conduction to the distribution of heat through the furnace made of an alloy of iron and chromium containing not less than 30% and not more than 60% of chromium.

2. An apparatus for roasting ores having such walls thereof as are exposed to the roasting temperatures and which contribute by conduction to the distribution of heat through the furnace made of an alloy of iron and chromium containing about 33% to 36% of chromium.

3. An ore roasting furnace having a hearth made of an alloy of iron and chromium containing not less than 30% and not more than 60% of chromium.

4. An ore roasting furnace having a hearth made of an alloy of iron and chromium containing about 33% to 36% of chromium.

In testimony whereof I affix my signature.

COLIN G. FINK.