Jan. 10, 1961 F. HARDERS 2,967,768

PROCESS FOR DESULPHURISING PIG- AND CAST-IRON MELTS

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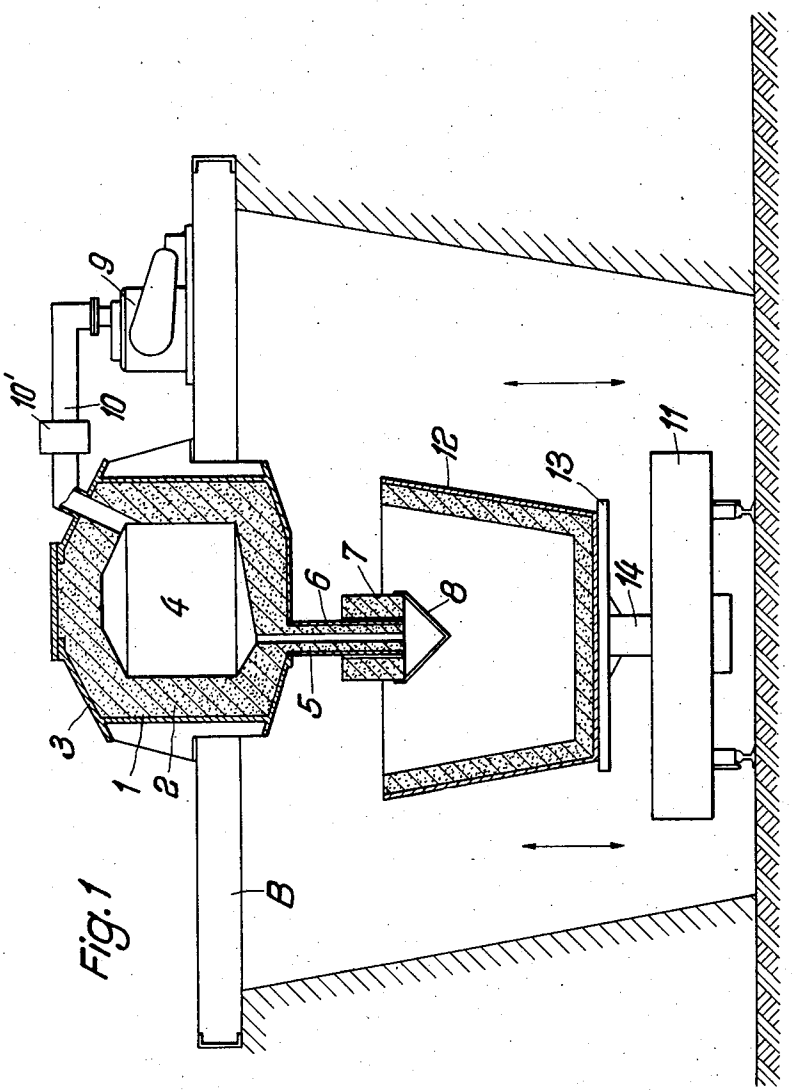


Fig. 1

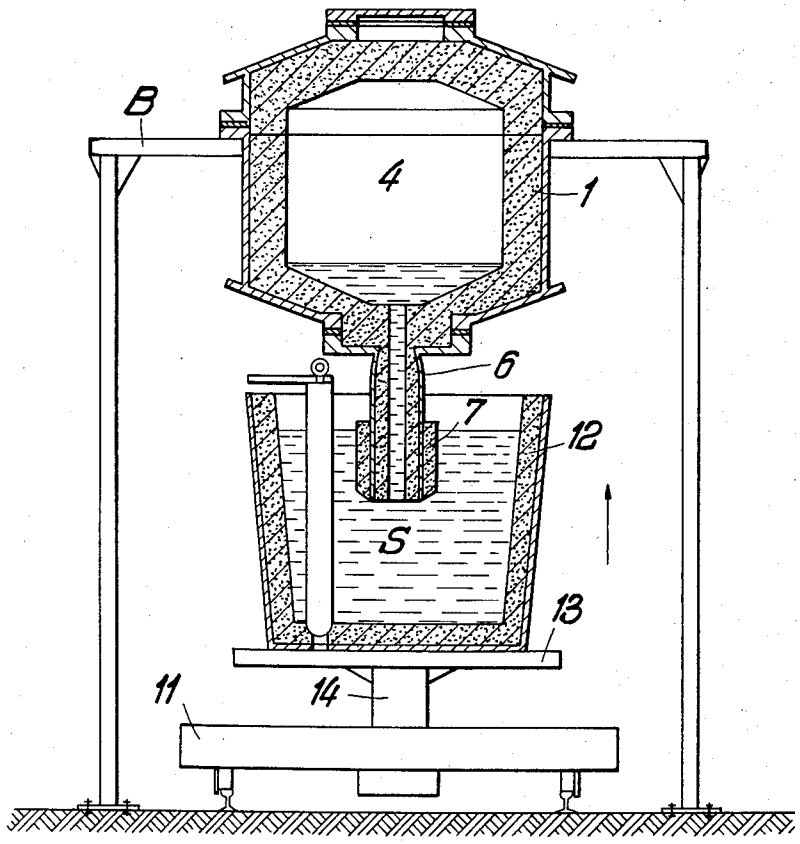
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Fig. 2



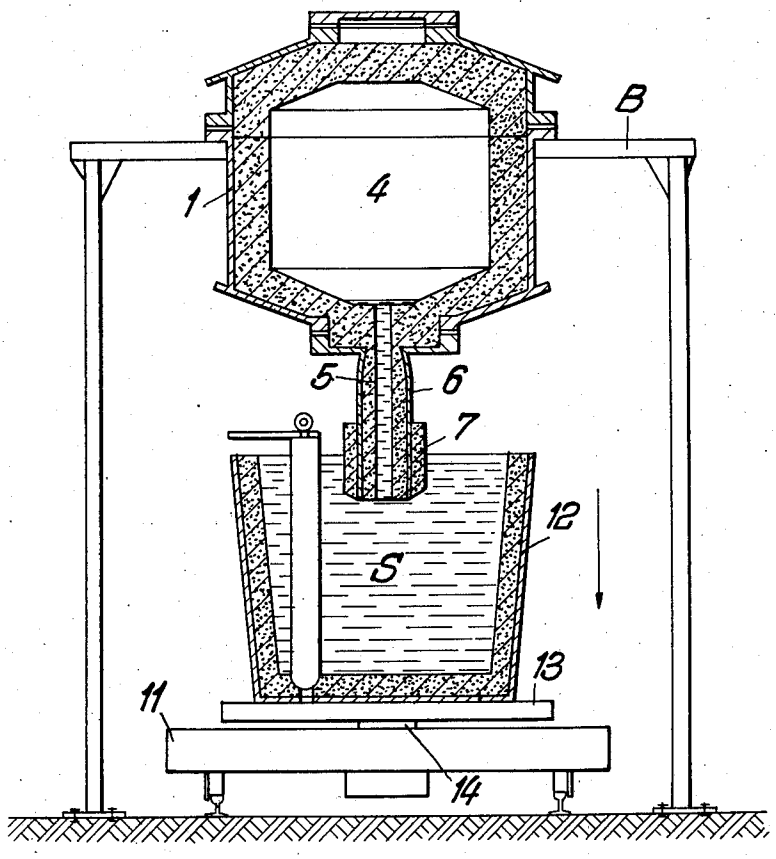
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Fig. 3



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PROCESS FOR DESULPHURISING PIG- AND CAST-IRON MELTS

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1 Claim. (Cl. 75—49)

It is known that pig iron and cast iron melts can be desulphurised with solid or liquid desulphurising agents, e.g. with lime, alkali metal oxides, soda or different salts, as well as with metals, such as magnesium and so forth. This is carried out at normal pressure, care being taken to ensure intimate mixing of the iron with the desulphurising agents.

In attempts to treat iron melts rich in carbon under reduced pressure, it has now been found that the sulphur contained in the pig iron and cast iron largely escapes in the vacuum in volatile form without the use of desulphurising agents. In the vacuum treatment of pig iron and cast iron melts, volatile, carbon-containing compounds of sulphur are mainly formed.

The subject of the invention is therefore a process for desulphurising pig and cast iron melts, which is characterised in that the iron rich in carbon is exposed to the influence of a vacuum.

Experiments with iron-carbon-sulphur melts which contained about 4% C and 0.2% S showed that the sulphur content of the melts could be lowered to about 0.067% in 30 minutes of vacuum treatment, without special agitation of the bath and without being influenced by desulphurising additions of known kind. The pressure employed was 10^{-3} mm. Hg. When the melt remained still longer in the vacuum, the sulphur content of the melt fell to 0.012% S. Since it appeared possible that a chemical combination of the sulphur with the alloying metals of the pig and cast iron might impair the desulphurising conditions, further experiments with different compositions of pig iron melts were carried out, and it was found that:

(1) The desulphurisation of the melt proceeds also in the presence of the usual substances which accompany the pig and cast iron;

(2) The desulphurisation already takes place at considerably higher gas pressures, e.g. at pressures up to 100 mm. Hg with marked speed, and that the speed increases as the pressure falls;

(3) Desulphurisation can be carried out at all temperatures above the melting point of the pig and cast iron melts, and

(4) Sulphur values of 0.005% can be obtained.

This is evident from the following examples:

Temp. of experiment in ° C.	Pressure in mm. Hg	Initial S-content, percent	S-content after—			
			10′, percent	30′, percent	1 h., percent	2 h., percent
1,580	10^{-3}	0.141	-------	0.060	-------	0.012
1,250	10^{-3}	0.055	0.050	-------	0.019	-------
1,250	5	0.049	-------	-------	0.021	-------
1,250	5.10^{-4}	0.060	0.021	-------	0.005	-------

It was further found that desulphurisation proceeds rapidly if a gas is passed through the melt either shortly before or while the melt is introduced into the vacuum, or if, in addition to the volatile sulphur compounds, another gas such as carbon monoxide is made to form in the melt during the vacuum treatment. Such gases exert a scavenging and distributing action and thereby help to accelerate the desulphurising reaction.

It was further found that the desulphurisation of pig and cast iron in vacuo can be markedly accelerated and increased in extent if it takes place in the presence of free carbon in the form of carbon which is practically free from sulphur or contains little sulphur, e.g. electrode carbon, which is charged before or during the desulphurising treatment in the form of a coarse powder or in pieces up to the size of a walnut, onto the surface of the pig and cast iron melt. To what the action of this additional carbon on the surface of the iron already rich in carbon is due has not yet been ascertained, but the fact remains that the free carbon on the pig iron to be desulphurised under reduced pressure considerably shortens the time required for desulphurisation and has an equally favourable effect on the degree of desulphurisation. These effects can be further increased by heating the surface of the pig iron melt to be desulphurised under reduced pressure to a temperature above the average temperature of the melt.

The economy and value of the process of the invention are influenced to a marked degree if the extracted sulphur compounds are recovered by freezing them out between the vacuum vessel and the pumps associated with it.

When carrying out the desulphurising process under reduced pressure on a large scale, it is suitable to agitate the melt in the vacuum and in some cases also to heat it.

The process of the invention and a particularly suitable apparatus for carrying it out will be described with reference to the drawings:

The desulphurising plant shown diagrammatically in vertical section in Figure 1 consists of a vacuum vessel **1**, mounted fixedly on the stage B and lined with refractory brick work **2** and enclosed air tightly by a metal jacket **3**. The effective space **4** within the vessel may be relatively small.

A pipe **6** lined with refractory brickwork **5** opens into the bottom of the vessel **1**. The end of the pipe is surrounded by refractory material **7** to the end of which a conical piece of sheet metal **8** is attached. The function of the core **8** is to push aside any slag on the surface of the steel melt S when the pipe **6** is introduced into it.

The pumping plant **9** which communicates with the effective space **4** in the vacuum vessel **1** through a pipe **10** is disposed beside the vacuum vessel **1** on the stage B. In the pipe **10** there is a device **10′** for freezing and recovering the sulphur compounds.

The pig or cast iron to be desulphurised is conveyed on a truck **11** to the vacuum vessel **1**. A ladle **12** containing the melt stands on a platform **13** which can be raised and lowered by a hydraulic cylinder **14**. Figure 1 shows the position taken up by the ladle and the pipe **6** which dips into the pig iron melt in the ladle, before the vacuum treatment begins.

Figure 2 shows the conditions when a vacuum has been established in the effective space **4** in the vacuum vessel **1**, and the ladle **12** standing on the platform **13** of the carriage **11** has been raised, thereby immersing the pipe **6** more deeply into the melt S of cast or pig iron. The cone S, which displaces the slag, has meanwhile melted and a part of the contents of the ladle has been raised about 1.4 m. by atmospheric pressure. In this process, the space **4** in the vacuum vessel **1** has filled up to the extent shown in the drawing.

When this part of the pig or cast iron has been kept under vacuum for some time, the ladle **12** is lowered without altering the vacuum in the vessel **1**, and brought to the position shown in Figure 3. The metal thereby flows back into the melt remaining in the ladle **12**, with the exception of some residual metal which remains in the

pipe 6. The raising and lowering of the ladle and the consequent inflow and discharge of a part of the pig iron present in the ladle 12 is repeated until the entire contents of the ladle have been desulphurised to the desired extent.

Instead of using the above described apparatus, vacuum vessels which are differently constructed and operate in a different manner may also be used for desulphurising pig iron and cast iron with recovery of the carbon-containing sulphur compounds. If the operation is carried out in batches, it is advisable to initiate a carbon monoxide reaction in the melt in the vacuum vessel and/or to agitate the melt by periodically altering the distance between a container which is disposed below the vacuum vessel and charged with pig iron and the vacuum vessel which communicates with the contents of the container by means of a pipe opening into the bottom of the vacuum vessel.

By treating cast iron by the method of the invention one obtains not only an iron having a low sulphur content but also a cast iron in which the graphite separates out in the form of spheroliths after the vacuum treatment, so that so-called spherolithic cast iron can be obtained in a particularly simple manner by the process of the invention, without the known additions, e.g. of magnesium.

I claim:

A process for desulphurizing pig- and cast-iron melts, which comprises, in combination, the steps of introducing

an iron melt rich in carbon into a heated vacuum vessel from a container disposed below said vacuum vessel and communicating with it through a pipe opening into the bottom of said vacuum vessel, applying a layer of carbon onto the surface of said melt in said vessel, the carbon being in the form of small pieces up to the size of walnuts and substantially free from sulfur, heating the surface of said charge to a temperature above its average temperature, subjecting said charge to the influence of a reduced pressure below 10 mm. Hg, periodically varying the distance between said vacuum vessel and said container, freezing out the sulfur compounds liberated during said vacuum treatment, finishing said vacuum treatment and emptying the contents of said vacuum vessel into said container by increasing the distance of said vacuum vessel and said container when the sulfur-content of said melt has reached its predetermined value.

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