

UNITED STATES PATENT OFFICE

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SLAG DETECTION

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10 Claims. (Cl. 29-148)

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In accordance with current practice, after steel has been rolled into sheets or plates, it is customary to shear off one section after another until manual inspection indicates substantial freedom from slag.

Such procedure is quite expensive, not only from the standpoint of the labor involved, but primarily from the standpoint of maintaining very costly machinery inoperative over an appreciable period of time.

Despite the great amount of study and research that have been directed to a solution of this problem, there has been none of sufficient dependability prior to this time to replace the rather primitive method from which even the largest mills have never departed.

In the production of steel plate or sheet, the ingot is poured from an open hearth furnace into a mold for subsequent rolling to the desired form. In producing this ingot, a certain amount of slag is transferred to the mold along with the steel, and during the cooling process, most of the slag floats to the top of the ingot. As the cooling continues and the ingot solidifies, contraction produces a depression at the top of the ingot wherein the major portion of the slag is retained. Following solidification, the ingot is stripped from the mold and transferred to a soaking pit wherein a uniform temperature is established prior to rolling. Since the slag still remains in the uniformly heated ingot to be rolled, experience has shown that most of it will be found towards one end of the ultimate plate or sheet. However, there has been no way to tell just how much of the plate or strip will contain the slag and accordingly, the cut and try method already described has been practiced without exception.

By virtue of the present invention, this serious loss of time can be avoided and all of the slag inclusions can be located rapidly without even stopping the rolling equipment.

The method comprises introducing into a molten slag-containing metal a compound of a radioisotope miscible with the slag but substantially immiscible with the metal and detecting radioactivity of the body externally thereof. The method is particularly intended for use in conjunction with ferrous metals and the radioisotopes contemplated are gamma and beta emitters, the former being preferable where appreciable thicknesses of material are involved, the latter being suitable in conjunction with thinner materials. It is contemplated that the metal be cooled prior to the detecting step and

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that it be rolled prior to such step. The detection is preferably accomplished by scanning an entire surface of the body and marking any portion thereof at which radioactivity is detected. The radioisotope compound is preferably admixed with a radioinactive material prior to its introduction into the metal body so as to materially dilute or disperse it in order to obtain sufficient diffusion throughout the slag.

It is important that the radioisotope assume a form which will not be vaporized by the heat to which it is subjected in order to prevent its loss to the atmosphere. It should also have a reasonably short life or half life at the time it is employed to avoid any danger to the health of operators or ultimate users of the materials involved.

Whereas a substantial amount of knowledge remains to be uncovered with regard to radioisotopes and their characteristics, because of their half lives and the character of their radiations, the following radioactive isotopes suggest themselves as suitable for forming compounds compatible with the principles of this invention: Barium 140, Barium 131, Antimony 124, Cadmium 115, Cerium 141, Chromium 51, Indium 114, Iridium 192, Iron 59, Mercury 208, Osmium 185, Osmium 191, Rubidium 86, Ruthenium 103, Scandium 46, Tellurium 129, and Zirconium 95.

Detecting devices already well known in the art are eminently suited for use in practicing the present invention. Geiger counters are commercially available and well adapted to the needs involved.

Thought must be given to the nature of the daughter element into which a particular radioisotope decays to make sure that the radioactivity will not continue for an excessive length of time.

Among the many compounds that can be expected to produce the desired results are the chlorides of Barium 140 and Barium 131. However, for a given compound to qualify, consideration must be given to the half life, the time elapsing between the production of the isotope and its actual use in the method, and other factors that will become evident as schedules are developed.

Whereas a limited number of radioisotopes and their compounds have been proposed for purposes of illustration, these and other examples proposed should not serve as limitations upon the present invention beyond the scope of the appended claims.

I claim:

1. A method of locating slag in a body of metal,

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comprising introducing into a molten slag-containing metal a compound of a radioisotope miscible with said slag but substantially immiscible with said metal, and detecting radioactivity of said body externally thereof.

2. A method as set forth in claim 1 wherein said body of metal is ferrous.

3. A method as set forth in claim 1 wherein said radioisotope is a gamma emitter.

4. A method as set forth in claim 1 wherein said radioisotope is a beta emitter. 10

5. A method as set forth in claim 1 wherein said slag-containing metal is cooled prior to the detecting step.

6. A method as set forth in claim 1 wherein said slag-containing metal is rolled prior to the detecting step. 15

7. A method as set forth in claim 1 wherein the detecting step comprises scanning an entire surface of said body. 20

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8. A method as set forth in claim 1 wherein a mark is applied to any portion of said body at which radioactivity is detected.

9. A method as set forth in claim 1 wherein said slag-containing metal is reduced to strip form prior to the detecting step. 5

10. A method as set forth in claim 1 wherein said compound is admixed with a radio-inactive material prior to its introduction into said metal.

References Cited in the file of this patent

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