This invention relates to the treatment of iron and steel in the molten state with cerium. The use of cerium for the purification of the molten metal is an established practice in iron and steel foundry-work. The peculiar effect exercised by the addition of cerium consists in the fact that the latter reacts with certain impurities generally contained in the melt such as oxygen, sulphur, nitrogen or phosphorus, forming non-metallic compounds, which are then eliminated in the form of slag. Owing to its strong tendency to react with the said impurities, cerium should be generally preferred to other means tried for the same purpose; however the application of cerium produces a slag having a high melting-point and a high viscosity, both rendering the separation of the slag from the molten metal extremely difficult and thus constituting a drawback of the process which can be but imperfectly eliminated by overheating the metal, the latter procedure being limited by technical considerations.

We have now discovered that the separation of the reaction-products of cerium from the melt may be considerably facilitated in a simple manner by lowering the melting-point and thereby simultaneously reducing the viscosity of these reaction-products, this being effected by adding the cerium to the bath, not in the elemental form or as a cerium-iron alloy alone, but in combination with other suitable elements acting in a similar though less vigorous way, i.e., likewise forming non-metallic reaction-products with the impurities dissolved in the melt. We have found that vanadium, titanium, calcium, aluminium and silicon are suitable for this purpose, although we do not wish to limit ourselves to these substances.

Sometimes it is found desirable to incorporate small amounts of, e.g., vanadium or titanium, as an alloying metal into the iron. Therefore, a large percentage of these valuable additional constituents was absorbed by their reaction with the impurities contained in the bath; they were thus partly converted into slag and their effect as alloying substances was hereby diminished to a large degree. By applying these elements simultaneously with cerium, a further advantage of our invention is experienced. Owing to the greater chemical affinity of cerium, the greater part of the impurities contained in the bath is absorbed by the cerium present; only a comparatively small amount of the alloying metal is in this case consumed by the reaction, hereby lowering the melting point of the cerium-compounds formed, whilst the main part of the alloying substance does not partake in the reaction, but is left to exercise its effect as an alloying constituent of the iron. By this method, it is, at the same time, possible to limit more accurately the amount of the alloying metal contained in the iron after the process of purification is accomplished.

Following this method, alloys of 25 to 40 percent of vanadium and 2 to 40 percent of cerium, the remainder being iron, have proved particularly satisfactory when added in suitable proportions to the melt. The quantity of the alloy to be added to the melt and the preferable ratio between its vanadium and cerium contents are determined by the desired vanadium contents of the melt on the one hand and the amount of oxides and other impurities contained in the untreated melt on the other hand, the latter item being generally known from experience. For example, about one to two percent of an iron alloy containing about 30 percent of vanadium and 3 percent of cerium are added to an iron melt containing in addition 0.6 percent Mn the following impurities: 0.5 percent Si, 0.06 percent P, 0.05 percent S, 0.02 percent N, 0.02 percent O. In this case, the losses otherwise incurred by the formation of oxdyic and other vanadium-compounds are reduced to quite a small extent, the total amount of the vanadium added being left in the iron as an alloying constituent.

In all cases, where cerium is mentioned in the foregoing specification of our invention and in our claims, it is understood that "mischmetal" is included by this expression.

We claim:
1. The improvement of the method for the purification of iron and steel in the molten
state by the addition of cerium, consisting in lowering the melting-point of the cerium-reaction-products by adding vanadium together with cerium, thereby forming a slag, and separating the slag from the molten metal.

2. The improvement of the method for the purification of iron and steel in the molten state by the addition of cerium, consisting in lowering the melting-point of the cerium-reaction-products by adding vanadium together with cerium in the form of an alloy, thereby forming a slag, and separating the slag from the molten metal.

3. The method for the purification of iron and steel in the molten state, which consists in adding an alloy of from 25 to 40 percent of vanadium and 2 to 40 percent of cerium, the remainder being iron, to the bath, thereby forming a slag, and separating the slag from the molten metal.

4. The improvement of the method for the purification of iron and steel in the molten state by the addition of cerium, consisting in lowering the melting-point of the cerium reaction products by adding at least one metal of the group consisting of vanadium, titanium, and aluminium together with cerium, thereby forming a slag and separating the slag from the molten metal.

In testimony whereof we have hereunto set our hands.

MAX JAEGOR.
ERNST POKORNY.
GOTTHARD GOSSRAU.