My invention relates generally to titanium al-
loys for the treatment of ferro-metals and more
particularly to the metals of the cast iron. Such an
alloy for treating iron and steel to remove there-
from gaseous or other impurities that have in-
jurious effects upon the metal and to modify
the properties of such metals by incorporating
therewith titanium and silicon.

The ferro-titanium alloys in common use
are made either with about 7% carbon to insure
freedom from the comparatively inactive ni-
tride, or by the aluminothermic process to give
a low-carbon alloy of low melting point. Other
ferro-titanium alloys containing silicon have
been described, but are not widely used, probably
because of too high a melting point. The fusion
temperature of these alloys varies directly with
the carbon content, so that for low melting
points a low carbon content is essential.

For general use as a deoxidizer and scavenger
of molten steel, the ferro-carbon-titanium con-
taining about 7% carbon has a wide field of use-
fulness, and is the least expensive form of tita-
nium available, on account of ease of manu-
facture. For certain purposes however a low
alloy is desirable, as for example, when a content of metallic titanium, as distinct from
the carbo-titanium-carbide, is desired in an alloy, or when the titanium alloy used must have a low
fission temperature as in treating small quanti-
ties of steel or cast iron where rapid absorption
of the alloy in the melt is essential.

The only alloys heretofore available for such
purposes are the alumino-thermic ferro-tita-
nium, which suffers from the objection of an alu-
num content, not desired in many steels which
must be as clean as possible; and certain
alloys containing titanium and silicon. The
latter, as described in the literature, have been
made in such a way as would inevitably result
in a carbon content greater than 0.5% and the
fusion point would be not low enough to
compensate for the additional cost of such al-
loys as compared with the more generally used
and well known ferro-carbon-titanium.

I have discovered a new ferro-titanium alloy
containing silicon, which has a low melting point
and can be made without difficulty in an ordi-
nary electric furnace. The alloy contains not
over 1% carbon, and it is also practically free
from aluminum, thus permitting it to be used in
steels where no inclusions of alumina are per-
missible. It can be used to confer the benefits
of titanium-treatment on gray cast iron in small
ladles, and the strength of the iron is increased
about 25% by such treatment. Thus high-
strength iron may be made in small amounts
when desiring from a cupola-run of ordinary
eut iron without changing the charge in the cupola.

When incorporated in the flux coating on elec-
tric welding rods in a finely-divided form, this
improved alloy has been found to prevent the
formation of oxide and nitride of iron in the
deposited metal, which is thus made similar in
structure to a steel casting.

My improved titanium alloy is readily made
in the usual carbon-lined furnace by the simul-
taneous reduction of ilmenite which is a ferrous-
titanate (FeTiO₃) containing about 55% tita-
nium oxide with the balance iron oxide and silica
rock or quartz containing about 98% silica. These
ingredients are preferably crushed to
about half-inch size, though any size available
between 40-mesh and one inch lumps may be
used.

“Barley” coal is used for reduction, and a small
amount of ferro-carbon-titanium, for example
that described in the U. S. Rossi and Meredith
Patent No. 1,055,652 of September 24, 1912,
crushed to about ½ to ¾ inch size, is added in
place of the usual scrap iron in order to increase
the electrical conductivity of the charge. This
substitution of the high-carbon titanium alloy
for scrap-iron in the charge is an essential part
of my improved methods, for by this means I have
found it possible to obtain a satisfactory content
of titanium in the product without raising the
carbon content too high for good fusibility. If
scrap-iron is used in the charge, and the tita-
nium content of the product is raised by increas-
ing the proportion of titanium ore to silica in the
charge, it is found that the carbon content rises
with it, something I wish to avoid as hereinbe-
fore described. But by using ferro-carbon-ti-
nanium in the charge in place of scrap-iron, it
is possible to so adjust the proportions of tita-
nium ore and silica used as to obtain a new low
carbon ferro-titanium alloy containing over 15%
titanium with silicon content about 20% and not
over 1% carbon.

Such alloy made in this way contains 15 to
25% each of titanium and silicon, and less than
1% each of carbon and aluminum, the balance,
or about 55 to 60%, being iron. An example of a
furnace charge which has been used successfully
is as follows:— 32% ilmenite, 38% silica, 15% ferro-carbon-titanium, and 15% coal. Vari-
atations of this charge within approximately the
following limits are probably permissible:— Il-
menite 33 to 35%; silica 35 to 40%; ferro-car-
bon-titanium 12 to 18%; coal 12 to 20%. The coal may be so distributed through the mix to be charged that more is added in the final portions of the furnace charge than in the portions that are in the furnace longer. The furnace should be charged slowly, and should be tapped 20 to 30 minutes after the last of the charge is melted, as by that time most of the melt should have been reduced to metal.

I claim as my invention:
1. A low-carbon, silicon-containing, ferro-titanium alloy having a low melting point and being practically free from aluminum, and embodying a titanium content from 15 to 25%, a silicon content about 20%, from a trace to less than 1% of carbon, and the balance substantially iron.
2. A low-carbon, silicon-containing, ferro-titanium alloy having a low melting point and being practically free from aluminum, and embodying a titanium content from 15 to 25%, a silicon content about 20%, about 0.5% of carbon, and the balance substantially iron.
3. In the method of making a low-melting, silicon-containing, ferro-titanium alloy, practically free from aluminum, the step which consists in reducing titaniferous ore and silica in a carbon-lined furnace in the presence of ferro-carbon-titanium, the charge containing a reducing agent and a preponderating amount of iron for the production of said ferro-alloy having a titanium content above 15%, a silicon content less than 3%, and carbon less than 1%.
4. In the method of making a low-melting ferro-titanium alloy the step which consists in reducing in a carbon-lined electric furnace a charge containing approximately the following ingredients: ilmenite (30 to 35%); silica (35 to 40%); ferro-carbon-titanium (12 to 18%); and coal (12 to 20%) to form a ferro-titanium alloy containing over 15% titanium with silicon content about 20% and not over 1% of carbon.
5. In the method of making a low-melting, silicon-containing, ferro-titanium alloy, practically free from aluminum, the step which consists in reducing in a carbon-lined electric furnace a charge containing approximately the following ingredients: ilmenite 22%; silica 38%; ferro-carbon-titanium 13%; and coal 13%, to form a ferro-titanium alloy containing over 15% titanium with the silicon content about 20% and not over 1% of carbon.

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