METHOD OF MAKING ALUMINUM KILLED STEEL


No Drawing.Filed Dec. 7, 1956, Ser. No. 626,822

5 Claims. (Cl. 75—57)

This invention relates to alloys and methods of making steel and particularly to an addition alloy for imparting cold and hot ductility and for the addition of aluminum to steel with a minimum of little or no alumina. The steel industry has for a long time been faced with the problem of alumina segregation in aluminum killed steels. In particular, deep drawing sheet steel, such as is used in automobile body forming has presented recurring problems of alumina inclusion and unsatisfactory cold ductility. In ordinary aluminum killed steels, substantially pure aluminum is added in the ingot mold in the form of pellets or bars. Substantial quantities of alumina are formed by the interaction of the aluminum and oxygen in the molten metal and considerable quantities of this alumina are trapped and held as undesirable alumina segregation.

We have found an alloy by means of which steel may be aluminum killed and yet be free of those undesirable alumina segregations and at the same time have improved hot and cold ductility, particularly expressed in the form of improved impact values, improved reduction of area and elongation and improved plasticity at rolling temperatures.

The alloy of the present invention has the following broad range of composition:

70% to 96% aluminum
4% to 30% rare earth metals

The foregoing alloy may contain small amounts of the usual impurities found in aluminum, such as small amounts of iron, copper, nickel and silicon, without detrimentally affecting the effectiveness of the alloy. Preferably, however, we limit the range of our alloy to the following composition:

About 80% to 90% aluminum
10% to 20% rare earth metals

The single preferred alloy composition is about 20% rare earth metal and 80% aluminum.

We have found that the alloy is preferably added to the steel in the form of pellets or balls weighing between ½ ounce and 3 ounces, or in notched bars weighing 1 pound to 5 pounds. Preferably, the alloy is added to the ladle before tapping the steel into the ladle in amounts between about 1½ pounds to 5 pounds per ton of steel, preferably about 2½ pounds per ton of steel. We have also found that the alloy may be added to molds preferably by hanging the alloy in the form of a rod in the central area of the mold and pouring the steel into the mold around the alloy rod.

We have found that the alloy of the present invention and the practice outlined hereinabove makes possible the almost complete elimination of alumina and alumina inclusions. We have also found that cold ductility is markedly improved so that the steels are more adaptable to difficult forming jobs.

We have found also that there is a greater efficiency in the use of the alloy of the present invention over ordinary aluminum used for killing steel. The efficiency of the present invention is perhaps most clearly set out by the following example:

A bifurcated heat of steel was poured into two ladles of about 170 tons each. In one ladle 850 pounds of conventional 95% aluminum (810 pounds aluminum) was added. In the other ladle 900 pounds of the alloy of the present invention containing 10% rare earth metals and 90% aluminum was added (810 pounds of aluminum). Analysis showed that the steel in the ladle containing ordinary aluminum obtained an aluminum efficiency of 11.7% and a residual aluminum of 0.026. The steel from the ladle treated with the alloy of the present invention showed a 23% efficiency on the aluminum and an aluminum residual of .05. Comparison of these two steels makes it quite clear that the alloy of the present invention is capable of improving the efficiency of the aluminum additions by about 100% with the residual aluminum increased to about double that which can be expected from conventional aluminum additions.

We have set out hereinabove certain preferred compositions and practices according to our invention. However, it will be understood that the invention may be otherwise embodied within the scope of the following claims.

We claim:

1. The method of reducing alumina segregation and imparting hot and cold ductility to aluminum killed steel comprising the steps of adding to a ladle an alloy of about 4% to 30% rare earth metals and the balance aluminum with usual impurities in ordinary amounts, pouring into the ladle a molten bath of steel to be killed and thereafter teeming the molten product into molds.

2. The method of reducing alumina segregation and imparting hot and cold ductility to aluminum killed steel comprising the steps of adding to a ladle about 1½ to 5 pounds per ton of steel, an alloy of about 4% to 30% rare earth metals and the balance aluminum with usual impurities in ordinary amounts, pouring into the ladle a molten bath of steel to be killed and thereafter teeming the molten product into molds.

3. The method of reducing alumina segregation and imparting hot and cold ductility to aluminum killed steel comprising the steps of adding to a ladle about 3½ pounds per ton of steel, an alloy of about 4% to 30% rare earth metals and the balance aluminum with usual impurities in ordinary amounts, pouring into the ladle a molten bath of steel to be killed and thereafter teeming the molten product into molds.

4. The method of reducing alumina segregation and imparting hot and cold ductility to aluminum killed steel comprising the steps of adding to a ladle a rod of an alloy of about 10% to 30% rare earth metals and the balance aluminum with usual impurities in ordinary amounts spaced from the walls of an ingot mold, teeming molten steel about the rod until the mold is filled and holding the metal in said mold until solidification occurs.

5. The method of reducing alumina segregation and imparting hot and cold ductility to aluminum killed steels comprising the steps of adding about 1½ pounds to 5 pounds per ton of an alloy of about 10% to 30% rare earth metals and the balance aluminum with usual impurities in ordinary amounts to the bottom of an ingot mold, teeming molten steel into the mold to fill it and holding the metal in said mold until solidification occurs.

References Cited in the field of this patent

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- Aluminum in Iron and Steel, Case and Van Horn, 1953, pages 46–47.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,980,529

April 18, 1961

William E. Knapp et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 49, for "earch" read -- earth --;
column 2, line 47, for "molden" read -- molten --.

Signed and sealed this 12th day of September 1961.

(S SEAL)
Attest:

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Attesting Officer

DAVID L. LADD
Commissioner of Patents
USCOMM-DC