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FREE MACHINING STEELS OF IMPROVED TRANSVERSE MECHANICAL PROPERTIES AND METHOD OF MAKING SAME
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This invention relates to free machining steels and method of making same.

There are many types and grades of steels which fall within the classification of "free machining steels" and which possess the quality of machinability as the result of the addition of sulphur thereto and which are, therefore, frequently referred to as resulphurized steels. Examples of such resulphurized steels are the 1100 series of carbon steels, the 416 and 430F types in martensitic and ferritic stainless steels, the 303 type in austenitic stainless steels, and resulphurized high speed steels.

The presence of the long stringers of iron manganese sulphides is a well known characteristic of these resulphurized steels, such stringers occurring as a result of the formation of these sulphides due to the addition of sulphur. It has long been recognized that the presence of these sulphide stringers in the steel results in inferior corrosion resistance, ductility and loss of surface quality, as well as poor transverse mechanical properties as a result of elongation of the sulphide stringers due to rolling and in the direction of such rolling, but these disadvantages have been universally accepted in compromise for greatly improved machinability.

It is an object of this invention to provide a resulphurized steel which is free from iron manganese sulphide stringers and which, as a result, possesses improved transverse mechanical properties.

Another object of the invention is to provide a method of producing a resulphurized steel of desirable free machining quality and which possesses substantially unimpaired corrosion resistant and transverse mechanical properties.

Another object is to provide a resulphurized free machining steel which possesses higher quality surface characteristics and which does not suffer from decreased ductility whereby production operations, such as cold-heading, would be impaired.

In accordance with the invention, uranium is added to the steel melt with the sulphur in the production of resulphurized steels in sufficient quantity to react with the sulphur present to form uranium sulphides. These uranium sulphides are formed as small round or cubic particles which are present in the steel as small and widely dispersed, substantially evenly distributed inclusions, minimizing any directionality which would adversely affect transverse properties.

Since uranium possesses an affinity for the sulphur present, the formation of stringers of iron manganese sulphides is substantially completely avoided.

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Since the uranium sulphide is in the form of round or cubic particles widely distributed throughout the steel, there is a minimum impairment of mechanical properties in the transverse direction.

The uranium is added in a quantity approximately corresponding to its stoichiometric relation to the sulphur present. Such relation is 7.5×percent S. For practical effective purposes, a quantity of uranium of 1 to 9 and preferably about 2 to 5 times the percentage of sulphur present is added.

Tests have been made which show that the machinability of steels produced in accordance with the invention is not impaired.

The following table gives the results of elongation tests carried out in respect of Type 416 steels containing carbon about .10%, chromium about 12%, sulphur about .25% and uranium as indicated:

	Percent U added	Ratio of Transverse to Longitudinal Elongation, Percent
(1) -----	0	0.560
(2) -----	0.12	0.600
(3) -----	0.33	0.775
(4) -----	0.83	1.000

It will be observed that the addition of uranium to steels results in a transverse elongation approaching the longitudinal elongation and that, in the case of steel (4), the most favourable condition has been achieved in that the ratio is unity.

We claim:

1. A method of producing a free machining resulphurized steel which comprises adding uranium with sulphur to the steel melt in a percentage thereof approximately 1 to 9 times that of sulphur present to react with substantially all of the sulphur present and form uranium sulphides.

2. A method of producing a free machining resulphurized steel as defined in claim 1, wherein said uranium is added in a percentage approximately 2 to 5 times the percentage of sulphur present.

3. A method of producing a free machining resulphurized steel as defined in claim 1 wherein said uranium is added in a percentage approximately 7.5 times the percentage of sulphur present.

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