April 14, 1959 M. HENRY 2,881,822

IMPROVEMENT OF THE TENSILE STRENGTH OF METAL PRODUCTS

Filed Nov. 1, 1955

Fig.1

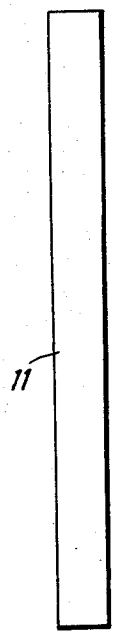


Fig.3

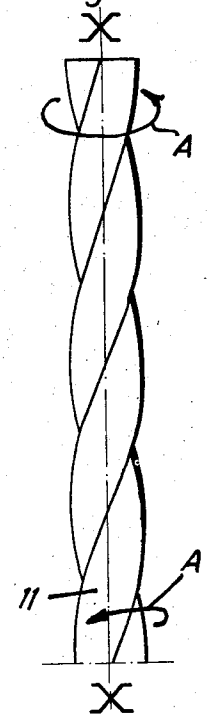


Fig.4

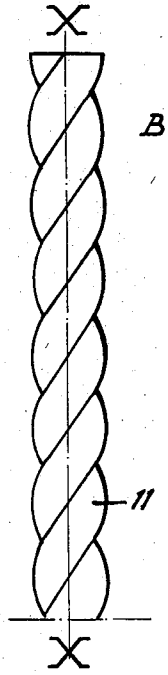


Fig.5

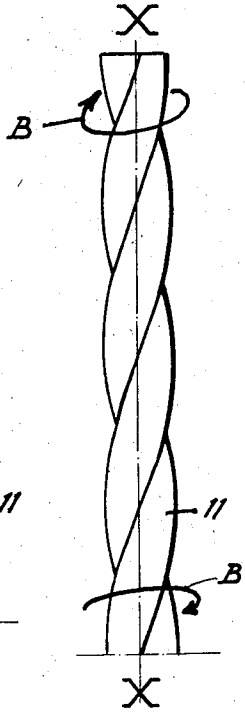


Fig.6

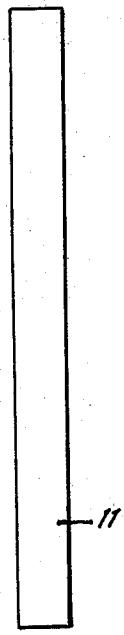


Fig.2

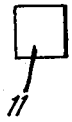
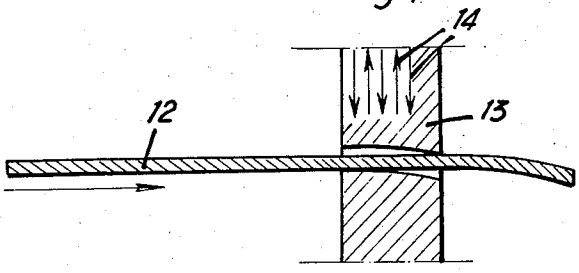


Fig.7



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IMPROVEMENT OF THE TENSILE STRENGTH OF METAL PRODUCTS

Maurice Henry, Saarbrucken, Saar Territory

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Claims priority, application France November 3, 1954

3 Claims. (Cl. 153—78)

This invention relates to the improvement of the tensile strength of metal products.

The invention relates more particularly to a method for increasing the tensile strength of hot rolled steel rods of the type used in reinforced concrete.

Heretofore, concrete reinforcements have been cold worked by cold twisting following a hot rolling operation. During cold twisting, the shape of the rod is deformed into a helical shape, and this is the reason why we can today discover in most steel rods for concrete a twisted external shape. While the deformation is of no particular disadvantage for rods with a square cross-section, particularly where they are later on hidden within the concrete mass, similar twisting for increasing the tensile strength in other shapes is characterized by great disadvantages. For instance, if it is desired to increase the tensile strength in a C-beam, or in an I-beam, cold twisting would certainly increase the strength, but the deformation would render the resulting product practically useless.

The instant invention has among its principal objects to increase the tensile strength within a hot rolled elongated steel product without, however, imparting to the final product a deformation as compared to the shape when it emerges from the rolls of the rolling mills.

Broadly speaking, this is accomplished by subjecting the elongated steel product to a first twisting while it is still hot; and after the product has cooled it is subjected to a second twisting, applied in a direction opposite to the first twisting. The second or reverse twisting is a cold working during which the product will be returned substantially to the shape it had prior to the first twisting. Thus, the second twisting imparts to the product the increase in tensile strength by cold working returning it, however, to the original shape instead of twisting it into a deformed shape.

More particularly, the instant method provides for working the steel products by means of two succeeding operations:

(1) Twisting metal products, such as rolled steel sheets, strip, wide strip, flats, channels, T-iron or other rolled steel beams, rails, sleepers, angles, ship building sections, axles, solid wheels, pit props, pipes, etc. in the hot state, namely immediately after rolling above 600° C., by torsional twisting in such a manner that torsional changes perpendicular to the direction of future tensile or compressive stresses or deflections under load, are obtained, namely generally around the longitudinal axis, and (2) eliminating at a lower temperature, namely in the cold state or at a temperature at which the metal possesses the highest tensile strength, by reverse twisting, the torsional deformation previously produced, the extent of which must be of such nature that its elimination at the lower temperature causes in the highest possible part of the cross-sectional area of the metal, torsional stresses superior to the stresses corresponding to the drawing limit.

In practice, the rolled products are passed, after leaving the rolling mill rolls, to a twisting machine and after

partial or entire cooling, they are again passed through the same machine.

The instant invention has its widest field of application in connection with profiled steel beams or bars which would become deformed in shape by normal twisting about the longitudinal axis. Conversely, the invention will generally not be applied, as unnecessary, to beams with circular circumference, such as cylindrical rods, tubes, wheels or the like. While the instant invention demonstrates its advantages most strikingly with irregular beams such as C-beams, or I-beams, it will be explained in detail in the following in connection with a beam of square cross-section and in connection with a steel sheet strip.

In the appended drawing,

Fig. 1 is a fragmentary elevational view of a hot rolled steel rod with a square profile;

Fig. 2 is a plan view thereof, revealing the square profile;

Fig. 3 is an elevational view similar to Fig. 1, but showing the rod partially twisted at elevated temperature;

Fig. 4 is an elevational view similar to Fig. 3, but showing the rod after the hot twisting has been completed;

Fig. 5 is an elevational view similar to Figs. 3 and 4, but showing the rod during the succeeding cold twisting in reverse direction, after the cold twisting has partially been completed;

Fig. 6 is an elevational view similar to Fig. 1, showing the rod after the cold reverse twisting has been completed; the rod in Fig. 6 resembles in appearance that of Fig. 1, but it has received a cold working and thereby has received an increased tensile strength; and

Fig. 7 is a fragmentary sectional view of a press in which a strip of steel sheet is being twisted.

In the drawing, the rod **11** of Fig. 1 has emerged from the profiling rolls of a rolling mill, and has retained its heat at above 600° C. The rod **11** is then subjected to a first twisting at that elevated temperature of above 600° C., by applying torque to the opposite ends relative to each other in the opposite directions A, as shown in Fig. 3. This hot twisting imparts torque to the rod **11** about the longitudinal axis X—X of the rod **11**.

The shape of the rod **11** upon completion of the hot twisting is shown in Fig. 4.

Subsequently, the rod **11** is subjected to a second twisting in the reverse direction, namely by applying torque in direction of the arrows B (Fig. 5) tending to undo the previous hot twisting. This second or reverse twisting takes place at a lower temperature than the preceding hot twisting, and may take place at a temperature for normal cold working. As previously stated, the reverse twisting may take place at a temperature at which the metal possesses the highest tensile strength. The reverse twisting (in the directions B) is continued until the rod **11** has resumed the original shape (Fig. 6).

The extent of hot twisting will, in effect, depend on the extent of the subsequent cold twisting needed for a desired increase in tensile strength to be imparted to the product by the cold working by the time the cold twisting operation ceases. The hot twisting must be such that the desired amount of succeeding cold twisting will return the rod **11** to its original shape.

Fig. 7 shows a strip of steel sheet **12** which is moved horizontally through a press **13** for twisting in a direction of vertical arrows **14**.

As pointed out before, the hot and cold twisting may be carried out successively in the same twisting machine, such as for instance the press **13**.

The extent of the torsional deformation must be determined by tests.

Increasing the allowable stresses requires that the depth and momentum of inertia for a given cross-sectional area

of beams and channels are increased, which is facilitated by giving the web of the sections a corrugated shape in order to keep the deflection produced by load at a low value.

What I claim is:

1. A method for increasing the tensile strength of elongated rolled steel products comprising heating the product to an elevated temperature above the limit of a cold working temperature range and below the flow temperature thereof, applying to the product at said elevated temperature a torque, torsionally twisting the product about its longitudinal axis, thereafter cooling said product to a cold working temperature for the product below said limit, subsequently applying to said product a torque reversed relative to said preceding torque application by torsionally twisting said product about its axis oppositely relative to the preceding twisting for the same angular extent as the preceding first twisting, restoring the shape of said product substantially to the shape prior to the commencement of the first twising, the extent of deformation of said product by said first twisting being controlled by the

extent of reverse twisting needed for imparting the predetermined tensile strength increase to the product by the subsequent second twisting.

2. In a method according to claim 1 the step of performing the first twisting at a temperature of above 600° C.

3. Method according to claim 1, characterized therein that the first twisting takes place after the rolling and by utilization of the rolling heat.

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