Dec. 17, 1940. E. LUKÁCS 2,225,064

COLD WORKING METAL BARS

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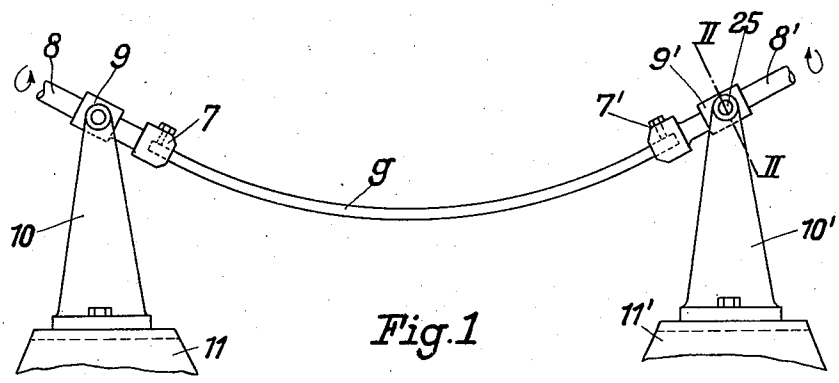


Fig.1

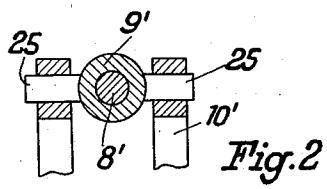


Fig.2

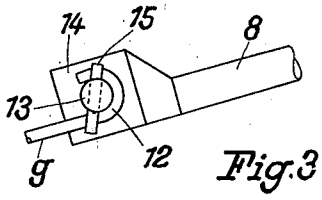


Fig.3
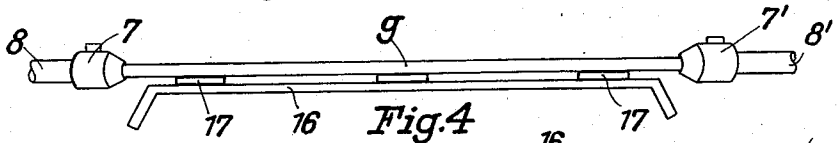


Fig.4

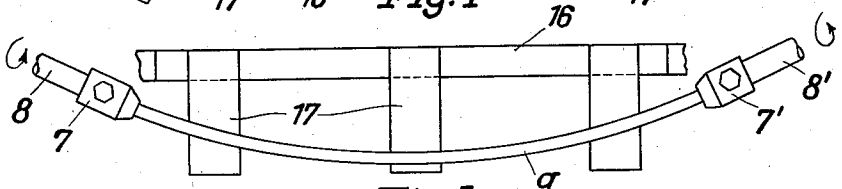


Fig.5

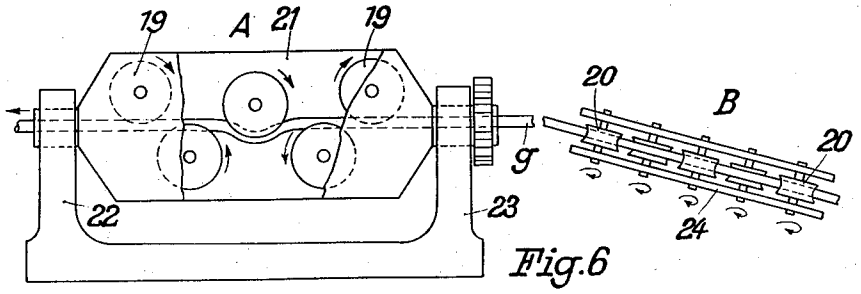


Fig.6

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COLD WORKING METAL BARS

Ernst Lukács, Budapest, Hungary

Application January 13, 1939, Serial No. 250,738
In Great Britain September 15, 1938

4 Claims. (Cl. 148—4)

The invention relates to a method of and apparatus for improving the strength properties of round or nearly round metal bars, particularly round iron bars, by cold working.

It is known that the yield point and also the tensile stength of most metals are raised by cold working which produces shearing stresses and/or normal stresses the value of which exceeds that of the yield point stress. In all cases in which the strength values are improved by cold working, it has been found advantageous to produce both kinds of stresses simultaneously. Thus, for example, when increasing the strength of inserts for reinforced concrete the shearing stresses were produced by twisting and the normal stresses by stretching the bars by means of weights. This method of procedure was also necessary for the reason that the twisting may produce lengthening of the bars, an increase of their original deviations from a straight line and also other irregularities.

When the usual iron bars of commerce were subjected to the afore-described improving process, the uniformity of the improved product did not by any means appear ensured, because the composite stress resulting from this method of loading may give rise to un-controllable, and sometimes even disadvantageous strength values for the resulting product, depending on the diffent strength values in the individual cross-sections of the original material subjected to cold working. This may be partly attributed to so-called segregation, i. e. the phenomenon of the migration of the carbon or the like more towards the middle of the bar during the rolling of the latter, so that the material in the middle portions has different strength properties from those of the peripheral layers of the bar.

The method of the present invention aims at achieving the raising of the yield point and thereby, in many cases, also an increase of the strength of round or approximately round metal bars by a new and improved method which has been evolved on the basis of practical experiments and theoretical considerations.

This end is attained according to the invention by cold bending or curving the bar and turning it about its thus curved longitudinal axis, so that any particular particle of any perpendicular cross-section rotates approximately about the tangent of the curved longitudinal axis drawn at this cross-section, i. e. of the curve of the bend, while said curve may be stationary in space or, if desired, perform oscillatory movements.

As a rule it is convenient first to bend the bar and then to subject the bent bar to the rotary movement, but it may also be convenient to effect the bending and turning of the bar simultaneously.

The angular velocity of the rotating particles of matter may be constant or varying along the bar; in the latter case torsion of the bar is, of course, produced.

The bending of the bar may be such as to produce permanent deformation of the bar, or else merely elastic deformation.

In carrying out the process, the curve of the bend may lie either approximately in one plane, or may represent a three-dimensional curve. The first-mentioned case is dealt with throughout in the present description, but it should be understood that this does not imply any restriction of the present invention thereto.

In addition, the bending of the bar may be produced by its own weight and/or by separate means.

The above-described disadvantages of known processes are completely eliminated by the method of the present invention, and further unexpected advantages are also achieved. While not wishing to limit me to any particular theory, I am of the opinion that the advantageous action and performance of the invention can be theoretically explained somewhat as follows:

It is well known that when a bar is bent, normal stresses are produced in the fibres lying in the plane of the bending moment, which are at a maximum at the periphery of the bar and decrease towards the neutral plane in which they have a value of zero, whilst shearing stresses are produced at a maximum in said neutral plane and disappear in the direction of the periphery.

If a bar be now cold bent according to the invention and gripped in rotatable clamping jaws at both ends, in the cold state, in such a way that the rotational axes of said jaws fall approximately in the tangent of the bending curve, and if the clamping jaws be then turned in the same sense and with the same angular velocity, the bar moves and behaves in similar manner to a flexible shaft or Bowden cable. During this rotation of the bent bar the particles of matter are subjected to repeated strains, while as a result of the rotation the stresses become uniformly distributed in the entire cross-section throughout the length of the bar in such a way that in the middle the shearing stresses are produced and towards the periphery the normal stresses. It is not necessary to proceed too far with the deformation, since the repeated and alternate displacement

and straining of the particles of matter during the turning of the bent bar effect a strengthening of the material even in the case of relatively small deformations. In the case mentioned above, when the process is carried out by simply turning a bent bar, it is necessary that the yield point should be exceeded during the bending of the bar, i. e. the bending should produce a permanent deformation, the improvement produced in the strength properties of the material being dependent both on the radius of curvature of the curve of the bend and on the number of revolutions performed.

If, however, the bar be turned in such a manner that the angular velocity along its length is variable, so that the bar also undergoes permanent torsion, the bending curve may be selected within the zone of resiliency, because the bending stress serves merely to initiate and regulate the torsional deformation. In this case the method affords the great advantage that there is no necessity to stretch the bars by weighting. Namely, the fact that the normal stresses are alternately produced as tensile and compressive stresses has the advantageous effect that the bar is straightened and the locally varying properties of the material are equalised. It is therefore no longer to be feared that the strength of the bar will be endangered by local increases of the composite stresses.

The apparatus for carrying out the method of the present invention may be of various types. Some embodiments are diagrammatically shown, by way of example, in the accompanying drawing in which:

Fig. 1 is a side elevation of one embodiment,

Fig. 2 is a section on line II—II of Fig. 1,

Fig. 3 shows a modification of the clamping device,

Fig. 4 is a side elevation, and

Fig. 5 is a plan view of another embodiment,

Fig. 6 is a side elevation of an embodiment designed for continuous operation.

In the embodiment of the apparatus shown in Figures 1 and 2, the ends of the bar *g* are gripped by two clamp jaws **7**, **7'**, respectively, the shanks **8**, **8'** of which are rotatable in jackets **9**, **9'** mounted pivotally about a horizontal axis on pivots **25** in brackets **10**, **10'** which are slidable upon base plates **11**, **11'**. Of course, all slidable and pivotable parts are fixed by suitable means in a desired position, before rotation is imparted to the jaws. Either both or only one of the jaws may be driven, as desired, or only one of the jaws **7** or **7'** may be rotatable while the other is stationary. It has been found convenient to mount both shanks **8**, **8'** pivotably, but one of them may be pivotable without being slidable on the base plate **11** or **11'**.

In the modification represented in Fig. 3, hooks **12** are formed at the ends of the bar *g* to engage a round peg **13** projecting from a block **14** fixed on the shank **8** as a substitute for the clamp jaw of Fig. 1. The engagement between hook **12** and peg **13** is secured by a wedge **15** driven into a wedge-hole made in peg **13**.

According to Figures 4 and 5, the bar *g* is bent in a horizontal plane, the clamps jaws being constructed and arranged in a manner similar to Fig. 1 but preferably pivotable in a horizontal plane. In this case it is, besides, supposed that the bar *g* is to be bent during the rotation imparted thereto by means of the clamp jaws **7**, **7'**, of which at least one is rotatably mounted. Flat supporting members **17** project from a base **16** to support the bar *g* in its deplacement while it bends during rotation. The bar rolls upon the even surfaces of the supporting members **17** and bends and as a result of this treatment its irregularities are compensated and a lengthening thereof takes place.

The loss of time attendant upon the insertion and withdrawal of the individual bars may also be avoided by designing the apparatus of the present invention for continuous operation. An example of such a design is diagrammatically shown in Fig. 6. Two rolling aggregates A and B, each comprising a plurality of rolls **19** and **20**, respectively, so cooperating in each aggregate as to grip and convey the bars *g* in a known manner, are so opposed to one another that their conveying directions enclose an angle, whereby the bars are bent, while one at least of the aggregates rotates as a whole around the bar *g* as rotational axis. In the example shown in Fig. 6, the aggregate A is rotatable, while aggregate B remains stationary. The rolls **19** of aggregate A are rotatably mounted in a composite frame **21** which in turn is rotatably mounted in two pedestals **22** and **23**, while the rolls **20** of aggregate B are rotatably mounted in a stationary frame **24**.

Obviously other suitable embodiments of devices for carrying out the method of the invention can be constructed in various other ways, which will be readily apparent to the man skilled in the art.

I claim:

1. A method of increasing the yield point and mechanical strength of roundish iron bars which have very large longitudinal dimensions as compared to their cross section and are adapted to serve as inserts for reinforced concrete, said method comprising bending the bar in the cold state and imparting rotation thereto about its curved longitudinal axis with varying angular velocity along the bar so that permanent torsion of the bar takes place.

2. A method as claimed in claim 1, in which bending is effected during the rotation of the bar.

3. A method as claimed in claim 1, in which the bar is bent within the limit of elastic deformation.

4. A method as claimed in claim 1, in which bending of the bar is effected within one plane.

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