July 29, 1941. M. SIMONS 2,250,610

WIRE AND WIRE MAKING

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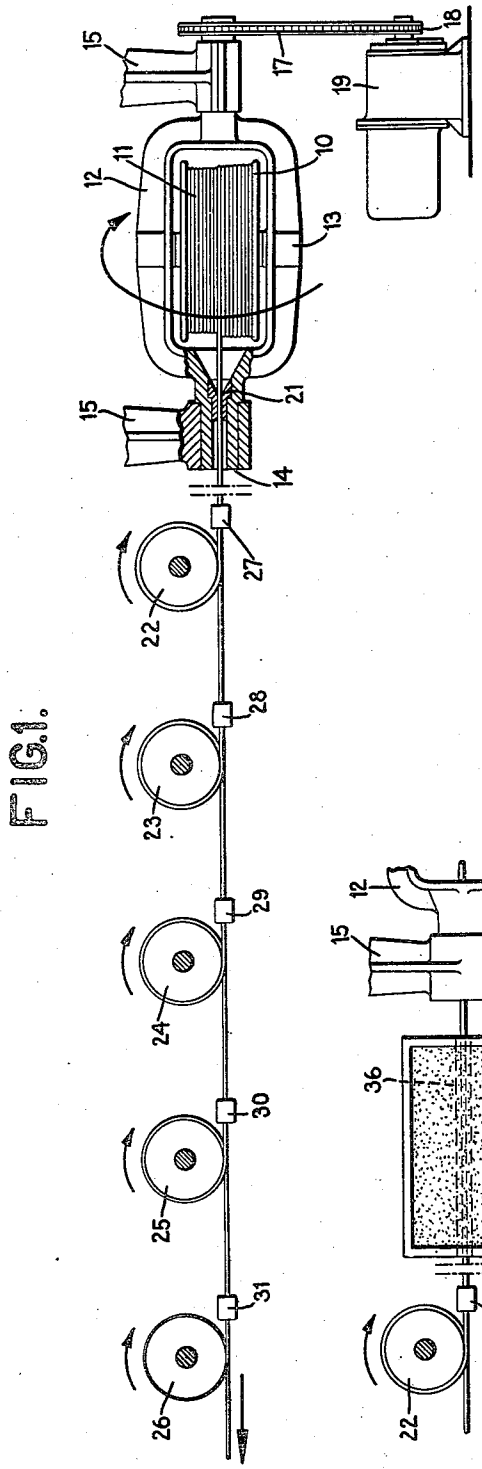



FIG. 1.




FIG. 2.

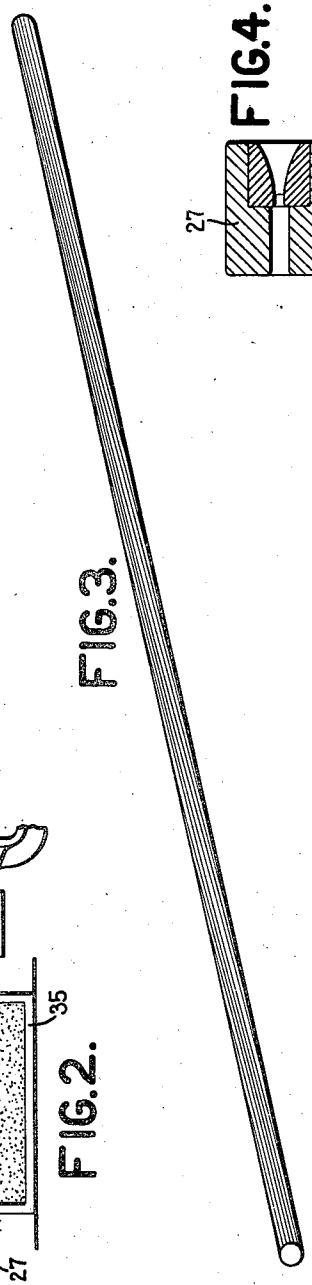


FIG. 3.




FIG. 4.

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## WIRE AND WIRE MAKING

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11 Claims. (Cl. 29—33)

This invention relates generally to the manufacture of wire, and has for its principal purpose the production of a wire which is better than prior wires of the same material and diameter in that the tensile strength and percent of elongation are greatly increased. For example, in some instances the tensile strength of a wire has been increased more than 20 percent by making it according to the present invention.

In the manufacture of wire a billet of metal such as iron, steel or brass, is heated to the temperature where the metal can be worked to the best advantage. Usually the billet employed is about 5" x 5" x 36". After the billet reaches the desired temperature it is passed through the various roll passes of a rod mill each of which compresses and works the metal and at the same time elongates it until at the final pass the billet has been converted into a round rod of from ¼ inch to ½ inch in diameter according to the final product desired. This rod is, at the end of the reducing operation, wound on a large spool or reel and is in that form transported to the wire drawing apparatus.

The successive working of the metal down to the final stage before it is wound on the spool results in the rod having a texture which may be described as consisting of parallel fibers or flow lines with the grains of the metal greatly elongated. The tensile strength of the wire varies according to the kind of metal, but in all of the metal produced as above described and used for wire making this condition may be seen by microscopical examination. In other words the raw stock ready for the wire drawing apparatus may be visualized as being something in the nature of a collection of parallel wires joined together along their sides.

The tensile strength of a rolled rod is being increased by various passes through dies and is being achieved through the compression of the long fibres when passing through a die, at the same time making the metal harder but doing it at the expense of the elongation factor. In other words, the harder the metal becomes the less elongation is found in that hardened metal.

The invention consists in twisting such a rod so as to give somewhat the same effect with respect to these parallel fibers as results from twisting wires together in forming a wire cable, so that load stresses are taken up by and distributed among all of the fibers instead of only a part of them, thereby preventing what might be termed individual breaks in the fibers because some of them are put under greater strain than others. In other words the load is taken by the fibers as a unit instead of individually.

The invention comprises one form of apparatus which is suitable for obtaining the result. While that form is highly satisfactory it is, as will be apparent later on, not the only one that can be used for imparting the desired twist to a rod which is to be drawn down to a wire. The method involved is new and the product is new and better in the respects above indicated than anything in the prior art with which the applicant is familiar.

In the accompanying drawing:

Fig. 1 shows in more or less diagrammatical form an apparatus for carrying out the invention.

Fig. 2 is in part the same as Fig. 1 but illustrates the use of a furnace for annealing the rod.

Fig. 3 shows on an enlarged scale a wire produced according to the invention with the twist lines indicated diagrammatically.

Fig. 4 is a cross-section illustrating the construction of one of the drawing dies.

The spool or reel of the raw stock to be used in drawing the wire is shown at 10, Fig. 1, and the rod at 11. The apparatus includes a frame 12 which can be constructed to receive a rod or support 13 passing through a hole through the center of the spool 10. The frame 12 is formed at its ends to provide trunnions or bearings 14 mounted in suitable supports 15. One of the trunnions or bearings is extended far enough to have attached adjacent its end a sprocket connected by a chain 17 to a driving sprocket or pinion, cooperating with the chain at the point 18, which may be in the armature shaft of a motor 19 or part of a gear box through which the motor drives the sprocket and chain 17. The motor is preferably of the variable speed type. By this construction the frame 12 may be rotated at whatever speed is desired for the particular material being worked upon. It is to be noted that the axis of the spool or reel is at right angles or substantially so to the axis of rotation of the frame 12.

Within one of the trunnions 14 of the frame 12 is a guiding die 21 which serves to center the rod 11 passing through the die with reference to the wire drawing mechanism. The purpose of the rotation of the frame 12 and spool 10 is to twist the rod 11, the degree of twist per unit of rod length being regulated by changing the speed of the motor 19.

The wire drawing mechanism is of a well known type and is represented conventionally by wire drawing drums 22, 23, 24, 25, and 26, of the

usual type which are driven at successively increasing speeds and impart draft to the rod or wire through a plurality of turns taken by the rod or wire around the drums. While five drums 22—26 are shown it is obvious that the number may be varied according to the number of reductions to be made in getting the wire down to the desired gauge. The rod or wire is drawn by the drums through successively acting wire drawing dies 27, 28, 29, 30 and 31, which may be of any standard or usual construction. As is well known such dies are rigidly held in supporting frame work and have their interiors shaped (as illustrated in Fig. 4) so as to compress, with consequent elongation, the metal that is drawn through them.

The first die 27 grips the rod tightly enough so that it limits the twist imparted to the rod by the rotation of frame 12. The distance between this die and the guiding die 21 may be varied according to requirements. The distance and speed of rotation are such that in making the twist there will be a full twist of 360° for each unit of length, the length of the unit depending on the material from which the rod 11 has been formed. In some instances a full twist can be made for each ½ inch of the rod length, while in others the full 360° twist cannot be made in less than 4½ inches without risk of damaging the metal in the rod.

The first die 27 not only holds the rod against rotation so as to limit the twisting effect but it also serves to smooth and compress the rod as it is drawn through the die by the drum 22, thereby giving the twist a permanent set in the rod which is maintained throughout the subsequent operations; the subsequent operations causing further reductions in diameter with resulting elongation of the metal as well as elongating the helix of the twist. The final product may have a twist in which there is a full 360° twist, for example, for each 6 inches in length of the wire, but this will depend upon the initial twist between the die 27 and the point of tangential contact on the reel 10, as well as the subsequent elongation of the wire.

Some materials, such as the higher carbon steel wires, Everdur, Permalloy, and many other alloy wires, do not lend themselves readily to the twisting operation without first being softened slightly and for such metals it is advisable to use a furnace 35 which is constructed to provide a heat zone which is long enough, and in which the heating agent may be regulated, so as to raise the rod to the desired temperature. This furnace is not illustrated in detail because the exact construction is not essential. It is preferred, however, to use a furnace in which the rod is protected by a tube through which the rod passes while being heated, or a furnace containing a non-oxidizing atmosphere through which the heat is transmitted. There are a number of furnaces on the market which are suitable for the purpose.

In working with, for example, a high carbon steel rod of ¼ inch diameter as the raw stock, the distance between the die 27 and the exit of the furnace 35 should be from 12 inches to 24 inches or more in order to give the rod time to cool sufficiently before it enters the die. This distance is, of course, subject to variations according to the material being worked upon and according to the lubricant used at the first drawing pass. If, as is quite common, the rod is allowed to cool in a cooling section of the furnace, this distance is not so critical.

Where the furnace is necessary the twisting of the rod is effected mainly in the heated zone of the rod; that is, most of the twist will occur in that part of the furnace where the metal is hottest. The twist will be smoothed out and set in the rod by the die 27 just as previously described in connection with cold drawing and thereafter the drawing operation is substantially the same as above described.

While the undoubted advantages gained in the way of greater tensile strength and a greater elongation factor appear to be due to what is in effect a twisting together of parallel fibers, it is not the desire to be confined to or limited by that theory. Regardless of the cause, in every instance where wire has been made according to the invention of copper, iron, steel and copper-coated iron or steel, a great increase in tensile strength and elongation was found and this important effect could not be accounted for in any other way by the applicant.

As a specific example of the result from using the apparatus and method hereinabove described, a ¼ inch copper rod has been given a twist of substantially 360° for every ½ inch of rod length and when this was drawn down to a wire of No. 13 gauge a full 360° twist for each 6 inches of the wire was found to exist in the wire, with an increase in tensile strength of over 10 percent.

It may, in some cases, be advisable to give the wire an additonal twist at an intermediate stage in the drawing operation. This can be done by drawing the stock down part way by an apparatus such as is illustrated in Figs. 1 or 2 and winding it on a spool, and then placing the spool in the frame 12 of a twister and repeating the twisting and drawing operation. The purpose in all cases is to get a wire with a twist in the metallic structure of as short a 360° helix per unit of length as is practicable without damaging the metal at any point in the twisting and drawing operation.

In all of the twisting operations the reel or spool 10 carrying the supply of raw stock may, if desired, be braked or its rotation retarded by any of the usual mechanisms to control the tension on the stock, or tensioning devices may be applied directly to the rod 11.

While the novel method and product and a suitable apparatus for practicing the invention have been described in detail it is not the desire to be limited by the description except to the extent indicated in the claims which follow.

What is claimed is:

1. A method of making a single stranded wire which comprises twisting a wire rod throughout its length to an extent just short of the point where the tensile strength of the rod will be lowered, and then reducing said twisted rod to a wire strand of the desired gauge.

2. The method of making a single stranded wire which comprises twisting a rod uniformly throughout its length, at least one complete twist being made for each twelve inches of rod length, and then cold drawing the twisted rod to down to the desired wire gauge.

3. A method of manufacturing wire from a wire rod which comprises drawing the rod by successive stages down to a wire of the desired final gauge by drawing through successively acting drawing dies, and progressively and continuously twisting the rod at the entering side of the

first die to supply for drawing a rod in which the metal is twisted.

4. A method of making a single stranded wire which comprises passing a wire rod through a heating zone, maintaining substantially a uniform degree of heat in said zone and a substantially uniform rate of passage of the rod through said zone, imparting a uniform twist to the heated portion of the rod, and drawing the twisted rod down to a wire of the desired diameter.

5. A method of making wire from a wire rod which comprises passing a wire rod through a heating zone, maintaining in said zone a degree of heat sufficient to anneal the rod, twisting the rod within said zone 360° for each twelve inches or less of the rod length, allowing the twisted rod to cool till it loses substantially its heat, and then drawing the twisted rod down to a wire of the desired gauge.

6. As an article of manufacture, a metal single strand wire in which the flow lines of the metal are disposed helically in the body of the wire while drawing the wire to increase substantially two percent or more the elongation factor of the wire.

7. As an article of manufacture, a metallic single strand wire in which the flow lines of the metal are permanently and uniformly disposed helically in the body of the wire to increase the tensile strength of the wire by cold drawing the wire down to the desired gauge from a uniformly twisted rod.

8. An apparatus of the character described comprising a support rotatable about a longitudinal axis and constructed to rotatably support a spool carrying coiled rod with the axis of the spool substantially at a right angle to the axis of the support, a wire drawing mechanism supplied by drawing rod from the spool, and means for rotating the support to twist the rod between the support and the wire drawing mechanism.

9. An apparatus of the character described comprising a support rotatable about a longitudinal axis and constructed to rotatably support a spool carrying coiled rod with the axis of the spool substantially at a right angle to the axis of the support, a wire drawing mechanism supplied by drawing rod from the spool, and means including a variable speed motor for rotating the support to give a predetermined number of complete twists to each unit of length of the rod between the support and the wire drawing mechanism.

10. An apparatus of the character described comprising a support rotatable about a longitudinal axis and constructed to support a spool rotatable on its axis and carrying a supply of coiled rod, the axis of the spool being at a right angle to the axis of the support, a guiding die rotating with the support and engaging the rod drawn from the spool, a wire drawing mechanism supplied by drawing rod from the spool, and means for rotating the support and spool to twist the rod as it passes between the wire drawing mechanism and the spool on the support whereby to supply uniformly twisted rod to the wire drawing mechanism.

11. An apparatus of the character described comprising a support rotatable about an axis and constructed to support a spool rotatable on its axis and carrying a coiled supply of rod, the axis of the spool being substantially at a right angle to the axis of the support, a guiding die rotating with the support and engaging the rod as it is drawn from the spool, a wire drawing mechanism supplied by drawing rod from the spool, means for rotating the support to twist the portion of the rod passing between the aforesaid guiding die and the wire drawing mechanism, and a heating device between said grip and said mechanism for heating the rod sufficiently to facilitate twisting while leaving the metal undamaged.

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