

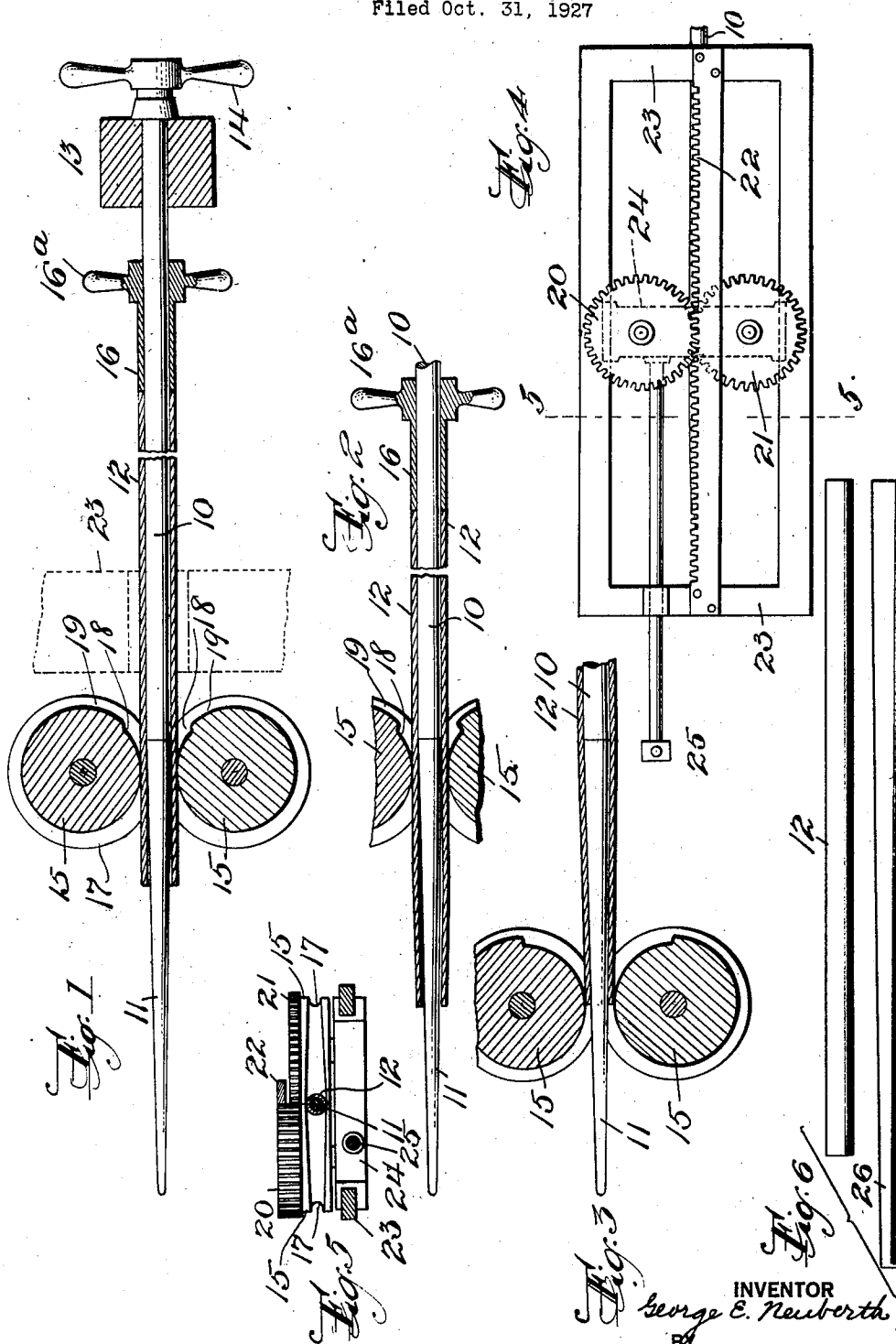
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METHOD OF TAPERING METAL TUBES

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METHOD OF TAPERING METAL TUBES

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The invention relates to an improved method of making tapered metal tubing and while the method can be applied to making tapered tubes of various sizes and shapes and of various materials it is particularly adapted to making steel tubing such as is used for making the metal shafts of golf clubs.

While tapered tubes are referred to herein as the final product, they may be merely the product of a given stage of working with some other shape as the final product. In any case the advantages of working the metal in the manner to be described hereinbelow will be obtained at some stage in the reducing process.

The method is an improvement in that it makes it possible to work steel with a high carbon content and shape a tube of cylindrical form into one of tapered form. The method also works the metal of the tube so that it is given a grain or, rather, it has an elongated longitudinal fibre established. This feature of the finished article is of advantage as it lends sufficient flexibility to the shaft and at the same time prevents excess bending whereby the necessary snap can be applied by the club when it is swung in making a stroke.

In carrying out my method I provide a mandrel with a taper to define the interior diameter and form of the finished tube and this tapered mandrel is flanked by two opposed rollers which rotate along the mandrel and have grooves which are deep at one end and shallow at the other end and are shaped to conform to the outer diameter of the finished tube. The rollers are spaced from the mandrel to give sufficient pressure on the tube placed between the mandrel and the rollers to form and work the material of the tube into tapered form. The rollers are passed over this toward the smaller end of the mandrel. The rollers are then rolled back to the starting point and another length, say, six inches of the tube, is fed forward over the larger end of the mandrel and the rollers again rolled toward the smaller end of the mandrel. This intermittent feeding of the tube and the rolling thereof is repeated until the entire tube or such part of it as desired,

is tapered. Each of the forming operations of the rollers is carried out to the end of the tube; so that each succeeding rolling is a little longer than the one preceding as a greater length of the tube has been fed forward on the tapered part of the mandrel.

By working the metal down the taper of the mandrel under compression in short increments of length the metal is permitted to flow forward freely without obstruction thus assisting in preserving the desirable characteristics of the metal. The use of rockers which reciprocate, rather than continuously rotating rolls, aids the smooth flow of metal because of their simple harmonic motion according to which they begin their actions at each end of their strokes easily and gradually and do not produce any sudden hammering action which would hinder the cold working of the metal and injure the stock and tools.

Another feature of the method is to give the tube a slight turn, say a quarter turn, each time the rollers roll back to take a new "bite" on the tube so that on this return the rollers compress the tube to consolidate the previously reduced metal, thereby rounding it up and removing any slight fin that might be formed on the tube by the previous compressing of the tube. This delivers a smooth tapered tube when the method is completed and there is no uneven surface to be ground off.

This return action effects what may be termed a consolidating action in that the grain structure is somewhat rearranged, the fins reduced as mentioned before they have been sharpened up, the eccentricity of the tube reduced, the tube loosened from the mandrel or given a more nearly round shape in cross section.

The invention will be better understood from an inspection of the drawings which show a simple means for practicing the method and producing a tapered tube of high carbon steel which needs no treatment other than hardening after it is shaped.

In the drawings, Figure 1 is a view, partly in section, illustrating a tube in the machine prior to the first compression of what will

be the small end of the tapered tube. Figure 2 is a similar view after the compression of the part first fed and showing the tube fed forward for the second compression. Figure 3 is a view showing the part advanced in Figure 2 after it has been rolled. Figure 4 is a top view of the carriage and frame on which the rollers are mounted. Figure 5 is a section on line 5—5 in Figure 4 and Figure 6 shows a tube both before and after it is tapered.

In the drawings 10 indicates the mandrel which has a tapered part 11 over which the tube is formed. The tube is usually cylindrical when it is placed in the machine and I show such tube at 12. The mandrel is rotatable being usually supported by a bearing 13 and is shown supplied with a handle 14.

The rollers 15 rotate along the sides of the mandrel and opposite the tapered part 16 of the mandrel. The rollers are provided with grooves tapering from the wide parts at 18 which are each of the same radius of one-half the large end of the taper to the small parts at 19 which are of the same radius as one-half the small end of the taper.

The rollers are rotated in unison by gears 20 and 21 which are in mesh and one of the gears is in mesh with a rack 22 which is fastened to the frame 23. The rollers are supported on a carriage 24 and the carriage is supplied with a handle 25 by means of which it can be pulled. These showings are elementary and hand-operated and it will be evident that they can be operated by power.

On the mandrel I place a sleeve 16 which has means such as the handle 16^a to feed the tube forwardly to the larger end of the mandrel so that the tube can be rolled repeatedly, each time for a greater length and toward the smaller end of the mandrel.

In carrying out the method I place the tube on the mandrel with a short length thereof, say six inches, on the tapered part at the large end thereof, as shown in Figure 1. The rollers are then drawn along the part on the tapered portion of the mandrel and rolls it out to conform to that part of the mandrel which it surrounds. Then the rollers are rolled back to the starting point and the sleeve 16 is used to feed the tube forward toward the smaller end of the mandrel as shown in Figure 2. Then the rolling is repeated as shown in Figure 3. These alternate feedings and rollings are repeated until the full length of tubing that is to be tapered has been fed over and compressed on the tapered mandrel.

This rolling of the metal gives it a longitudinal fibre and a complete tapered article as shown at 26 is the result.

The mandrel with the tube is turned part way around say a quarter turn, between the pressure and return strokes of the rollers so that any small fins raised by the forming or

pressure rolling are flattened out on the return rolling.

It will be evident that exaggeration of the relative thickness of metal in the tube as compared to the size of the rollers and mandrel is necessary in the drawings and that the parts shown are elementary and the mechanism can be operated by power in the commercial production of the article. It will also be evident that mechanism other than that embodying oscillating rolls may be employed for effecting the reduction, so far as certain aspects of the invention are concerned.

This method makes it possible to take high-carbon steel tubing and taper it, in the cold state, whereas, in the old methods, the tube is of low carbon steel and then it must be carbonized later and then hardened. By my method the tube of high carbon steel is tapered and hardened without any necessity of carbonizing the steel after the tube is tapered. Of course, other metals besides steel may be reduced by this method, steel being mentioned by way of example as one of the harder and more difficult metals to reduce.

I claim:—

1. A method of tapering metal tubes which method comprises supporting the tube on the inside upon a mandrel to define the taper, feeding the tube in successive increments along the mandrel toward the small end of the taper and forming the tube in successive steps as it is advanced and in the direction of its movement.

2. A method of tapering metal tubes which method comprises supporting the tube on the inside upon a mandrel to define the taper, feeding the tube in successive increments along the mandrel toward the small end of the taper and pressing on the tube in successive steps in the direction of the small end so that it is gradually tapered by repeated forming.

3. A method of tapering metal tubes which method comprises the provision of an element to support the tube on the inside and define the taper, then passing the tube along this element in successive increments of length from the large end to the small end and working the tube in successive increments by tapered segmental rolls in a direction from the large end toward the small while the tube is being advanced.

4. A method of tapering metal tubes which method comprises the provision of a longitudinally fixed tapered mandrel over which the tube is to be tapered, feeding a tube in successive increments of length along the mandrel from the large toward the small end of the mandrel, and rolling the increment and the previously rolled portion of the tube in successive increments toward the small end while the tube is traversing the mandrel.

5. A method of tapering metal tubes with a rolling element which method comprises feeding a tube intermittently along a tapered mandrel the feeding being instituted at the larger end of the mandrel and occurring just before the rolling element begins its forward movement, rolling the tube from the large end of the mandrel toward the small end at the intervals between feedings, and turning the tube rotatably just before the rolling element begins its return.

6. A method of tapering metal tubes which comprises, feeding the tube in successive increments over a tapered mandrel from the large toward the small end, rolling the tube successively down the taper of the mandrel, and rolling back up upon the tube but at a circumferentially displaced position without feeding the tube, the feeding and turning thus occurring singly and in alternation at opposite ends of the rolling for the purposes described.

In testimony whereof I affix my signature.
GEORGE E. NEUBERTH.

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