J. E. WILSON.

METHOD OF PRODUCING THIN HARD TUBES FROM DUCTILE METAL.

APPLICATION FILED MAR. 25, 1908.

987,093. Patented Mar. 14, 1911.

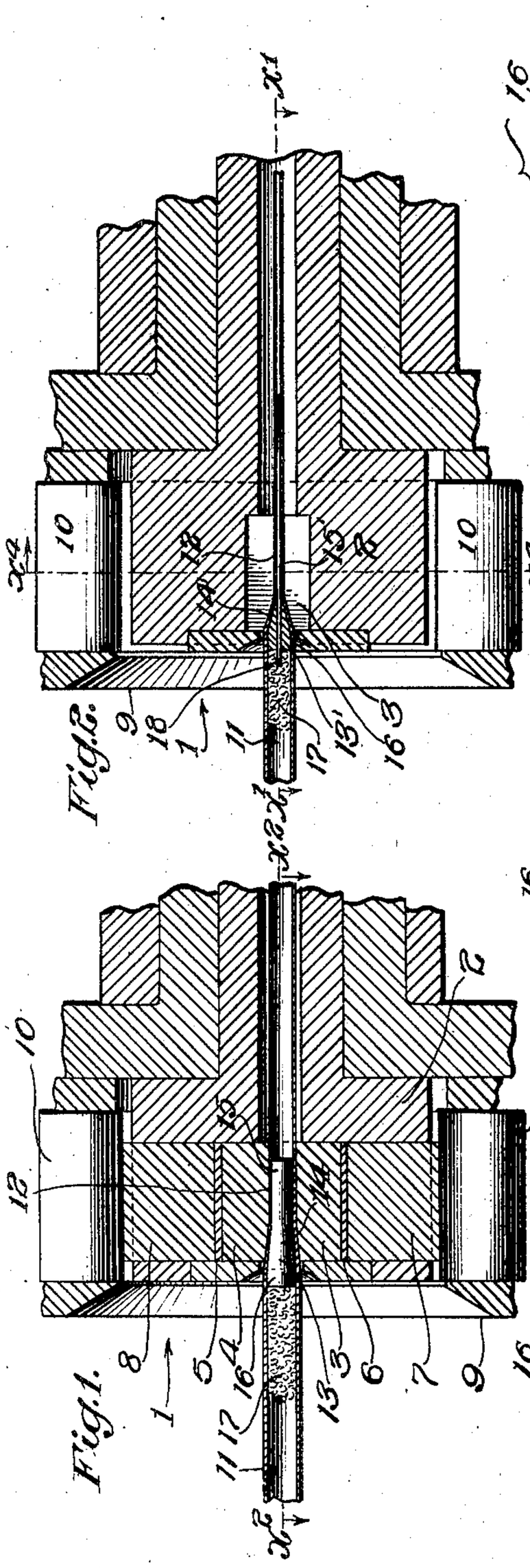

Fig. 2.

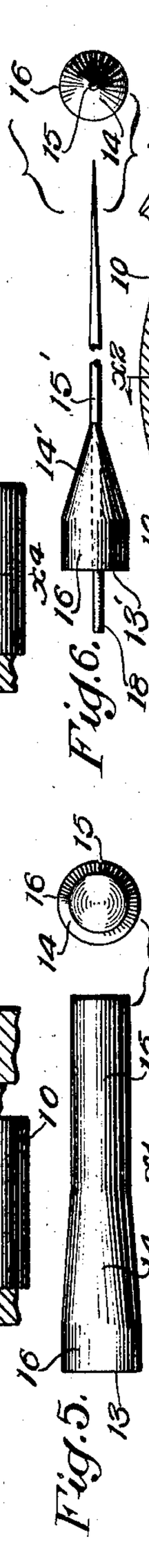

Fig. 6.

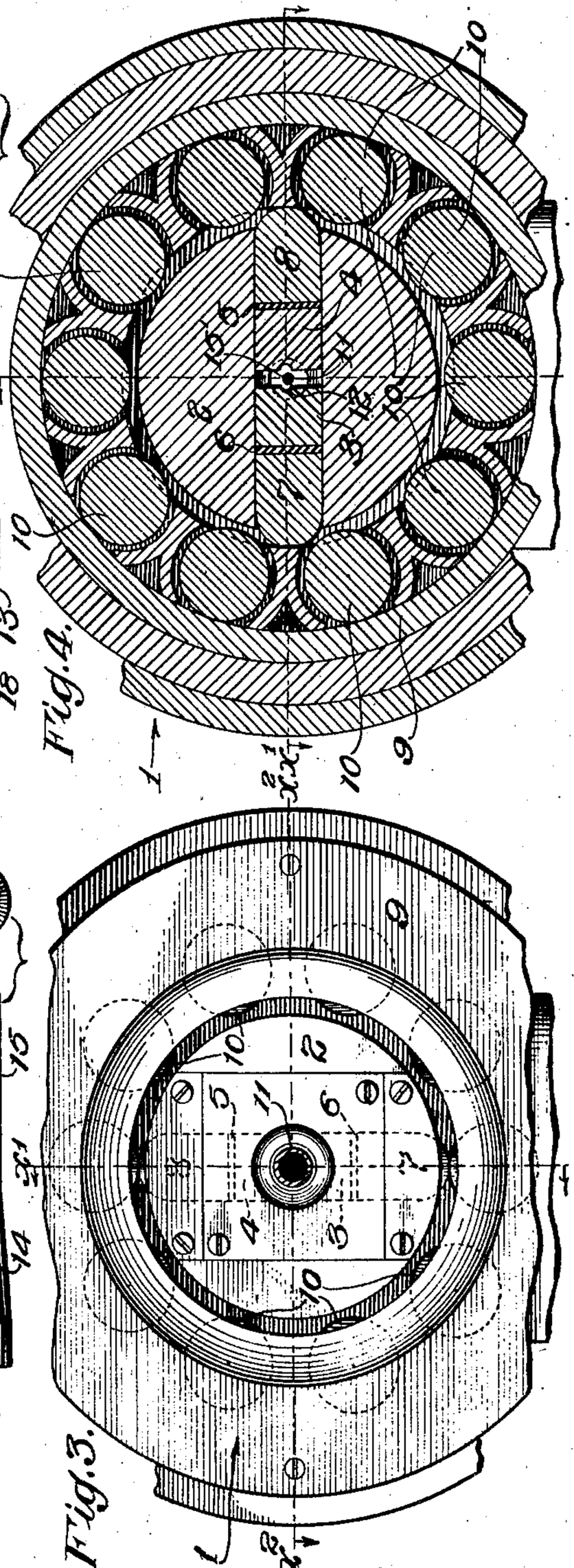

Fig. 4.

Fig. 1.

Fig. 5.

Fig. 3.

Witnesses:
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UNITED STATES PATENT OFFICE.

JOHN E. WILSON, OF LOS ANGELES, CALIFORNIA.

METHOD OF PRODUCING THIN HARD TUBES FROM DUCTILE METAL.

987,093. Specification of Letters Patent. Patented Mar. 14, 1911.

Application filed March 25, 1908. Serial No. 423,264.

To all whom it may concern:

Be it known that I, JOHN E. WILSON, a citizen of Canada, having declared my intention to become a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Method of Producing Thin Hard Tubes from Ductile Metal, of which the following is a specification.

An object of this invention is to make gold or other tubes of minute diameters and uniform thickness, rapidly and cheaply; at the same time hardening and condensing the material so as to make the tube suitable for use as a hypodermic needle. This is accomplished by introducing into the end of a ductile tube, as a tube of gold, a short, hard, strong, free swaging plug that is circular in cross-section and that has a frusto-conical body and a slightly tapering stake which projects from, and is of less diameter than the tip of said body; and then applying to the outside of the tube adjacent said body and stake and simultaneously on diametrically-opposite sides thereof, blows or compressive impulses in rapid succession and rotatively around the perimeter of the tube; at the same time lubricating said plug and the bore of the tube, and allowing the plug to move along the tube as the plug-body is squeezed by the reducing walls of the tube, and at the same time applying a determined resistance to impede the movement of the plug along and within the tube, whereby the blows thus applied simultaneously reduce the diameter and uniformly reduce the thickness of the material, thus producing at the smaller end of the plug and projecting therefrom a cylindrical tube having a cylindrical bore and being ready to receive a second plug of circular cross-section, also having a frusto-conical body and a cylindrical portion, whereby the operation of treating the reduced tube by blows, as before detailed, may be repeated, thus producing a tubular portion of reduced diameter and lessened thickness of walls. The process also comprises a repetition of the operation above detailed, until a tube of minute diameter and desired hardness and thickness of walls is produced; annealing of the tube after each reduction except the last being effected in any suitable manner.

The gold of the tube operated upon may be of any suitable fineness, as for instance, ten or fourteen carat gold; the purpose being in this respect to cheaply produce for surgical use a non-corrodible tube of small diameter.

It is to be understood that the invention is not limited to the size of the tube or the character of the material operated upon.

The production of gold tubes of suitable fineness and hardness for hypodermic needles has heretofore been attended with considerable difficulty in keeping the hole in the tube open and obtaining the desired hardness of the metal. I avoid this difficulty by the use in the manner substantially herein detailed of the above-mentioned free swaging plug inside of the tube to be reduced; the portion of the plug which I term the tip being adapted to keep the hole open and to serve as an internal resistance when the blows are struck on the outside of the tube, thereby causing thinning and condensing of the walls.

By the use substantially as herein stated of the free plug formed as set forth, it is made possible to reduce ductile tubes of any length and any size to any desired less diameter and thickness of wall, and to do this by machinery with great ease and rapidity; the extent of reduction being limited only by the ductility of the metal.

The invention may be understood from the accompanying drawings which illustrate means claimed in my companion application Serial No. 608,806, filed February 15th, 1911, as a division of this application.

In Figures 1, 2, 3 and 4, mechanical means that are constructed in accordance with the purpose of this invention and that may be employed in carrying out my newly-invented method are shown. Plugs of different diameters appear. In Fig. 1 is shown a plug that precedes the one shown in Fig. 2. Fig. 1 is an axial section on line x^1, Figs. 2, 3 and 4. Fig. 2 is an axial section at right angles to the section of Fig. 1 on line x^2, Figs. 1, 3 and 4. Fig. 3 is an end view of the device shown in Fig. 1, and also represents the outer portion of the device shown in Fig. 2. Fig. 4 is a section on line x^4, Fig. 2. Fig. 5 is an enlarged detail in side and end elevation of the free sliding plug shown in Fig. 1. Fig. 6 is a detail in side and end elevation of the sliding plug shown in Fig. 2. The side elevation in Fig. 6 is broken to contract the view.

1 designates in a general way a hammer-

ing device constructed after the manner of the well-known Dayton swaging machine. In this machine 2 designates a rotary spindle head that carries a set of dies 3, 4, face plates 5, 6, and backers 7 and 8.

9 designates the head that carries rollers 10.

In practical operation a relative rotary movement is produced between the spindle head 2 and the head 9, so that the rollers 10 will successively contact with the backers 7 and 8 to drive them inward. In practice it is customary to rotate the spindle head 2 at from 250 to 600 revolutions per minute so that there may be as high as 6000 distinct compressions or blows per minute on a tube 11 inserted into the open space 12 provided between the dies for its reception.

13, Figs. 1 and 5, designates a short sliding plug having a frusto-conical body portion 14, a reduced slightly-tapered tip 15, and may have a guiding portion or butt 16 which in some cases may be omitted. 13′, Figs. 2 and 6, designates a modified form of the same plug.

17 designates a wad of waste, or other yielding material that may be tightly inserted into the tube 11 before the plug 13 has been inserted thereinto to afford a measurable resistance to the plug 13, thus to assist in holding the plug in position to support the inside walls of the tube as the swaging operation proceeds.

The swaging faces of the dies 3 and 4 are of the usual form of swaging dies, tapering from larger to smaller diameter, and terminating in a straight portion to correspond with the plug 13 to be used. The swaging plug for any tube will have a butt portion 16 that may be more or less extended and is of the diameter of the bore of the tube to be swaged.

In practice, a gold tube of suitable diameter, say 7/16 of an inch, more or less, for instance, will be taken for reduction, and the operator will force into one end of this tube a resistance wad 17 of yielding material, such for instance, as light wool waste saturated with a suitable lubricant, as surgeon's green soft soap. Then the swaging plug 13 adapted for reducing that size of tube will be inserted into the end of the tube until the frusto-conical portion or shoulder 14 is fully chambered and the tube projects slightly beyond the junction therewith of the tapered, approximately-cylindrical tip 15 that is to support the tube against the hammering action of the dies. Then the end of the tube with the plug thus inserted will be inserted between the dies which will previously have been set to rotating at the desired speed. The operator will, as in the usual course of swaging, force the tube into and through the space between the dies which meanwhile hammer or compress the walls of the tube against the slightly-tapered reduced portion or tip 15 of the swaging plug, and also compress said walls against the more tapering frusto-conical portion or body 14 of the plug. This last-mentioned action causes the swaging plug to slip along inside the bore of the tube which becomes lubricated by the lubricant carried by the resistance wad 17, which, while serving to carry the lubricant, also affords a resistance to the advance of the swaging plug, thereby assisting to hold it in effective position, but allowing it to recede along the tube as the same is pushed through the space between the dies.

The intermittence of the force applied by the dies allows the tube to be pushed in between the blows in the ordinary manner of using said swaging machine, and as the tube advances and the dies are intermittently driven in and out by the alternate action of the rollers and of centrifugal force, and the force exerted by pressing in the tube, the swaging plug is squeezed along inside the tube and the tube is reduced in diameter and brought into position adjacent the tip against which it will be hammered by the portion of the dies adjacent the tip 15. As the dies hammer the tube against such tip, the material becomes greatly condensed and hardened and reduced in thickness.

The operation may be repeated with dies and swaging tubes of less and less diameter, annealing the tube after each reduction until the required diameter is reached. A uniform and true tube so minute as 14/1000 of an inch in diameter with a bore of 5/1000 of an inch in diameter, more or less, may be produced in this way as rapidly, easily and certainly as though the cylinder acted on were a rod.

In the plug 13′ used for final reduction to the thinnest diameter desired, the tip 15′ may be greatly extended, as indicated in Fig. 6 which is greatly magnified over actual size, and in which the reduced portion 15′ may be made of fine piano-wire ground down to the size and taper required. Said piano wire may be fastened to the main portion of the plug by boring such main portion of the plug axially and inserting the wire through and soldering it in the bore. Said piano wire may be allowed to project rearwardly from the plug, as shown at 18, and the solder, not shown, by which said piano wire is soldered in the plug may be of low fusing quality so that when the forwardly-projecting portion of the piano wire becomes attenuated by the hammering or by wear, the plug may be heated, thus melting the solder and allowing the plug to be slipped rearwardly on the piano wire until a new portion thereof of sufficient length comes into position to form a new tip. Then

such newly-projected portion may be properly ground to a slight taper, and the plug be ready for further use. The purpose of tapering the tip is to allow the same to slip along the tube with sufficient ease after the walls have been hammered thereon. Unless the tip is slightly tapered it will be so tightly gripped by the walls of the condensed tube that the plug will not slide in the tube. This stops the work.

Before starting the end of the tube into the space between the dies it is advisable to coat the outside surface of such tube with powdered rosin. This may be done by first heating the tube sufficiently to cause it to melt the rosin and then rolling the tube in the mass of powdered rosin, care being taken not to allow rosin to enter the tube. Then when the tube has cooled, the resistance plug and swaging-plug will be inserted as first-described.

I find it advisable in the process of reducing a tube from a considerable diameter to minute diameter, that the tube be annealed as often as possible, and it is advisable to make the reduction at each operation as slight as possible so as to avoid undue hardening until the final operation. At the final operation the reduction should be comparatively great in order to produce the desired hardening, but care must be taken not to reduce excessively for in that case the metal will be crystallized or split, or otherwise injured in its quality, and reduced in strength. To specify a concrete case, a needle of 23 gage, Brown & Sharp standard, which is 22/1000 of an inch in diameter, would be made from stock tube of 48/1000 to 52/1000 of an inch in diameter. The body core for making it would be 38/1000 to 42/1000 of an inch in diameter with a frusto-conical portion corresponding with the dies, and the tip of the finishing plug would be composed of piano-wire about 7/1000 of an inch in diameter, producing a hole in the final tube of like dimensions. Each wall of the finished tube in this case would be about 75/1000 of an inch in thickness.

What I claim is:—

1. The method of producing hard tubes of thin diameter from larger tubes of ductile metal, which consists in lubricating the inside of the larger tube and simultaneously reducing the diameter of the tube and condensing the reduced portion by a succession of blows delivered upon opposite sides of the tube, mean-while interiorly supporting the walls of the tube by a support that recedes under the force of the blows delivered upon the frusto-conical portion of the tube.

2. The method set forth of producing hard thin tubes from ductile metal, which consists in introducing into the end of a tube of ductile metal, a free plug circular in cross-section provided with a frusto-conical body and with a slightly tapering stake, that projects from, and is of less diameter than the tip of said body, and then swaging the tube upon said body and stake at the same time permitting the free plug to slide along inside the tube responsive to the swaging action upon the conical body, and simultaneously therewith causing a sufficient resistance to be exerted against the progress of the plug to allow swaging to be effected.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 19th day of March, 1908.

J. E. WILSON.

In presence of—
JAMES R. TOWNSEND,
M. BEULAH TOWNSEND.