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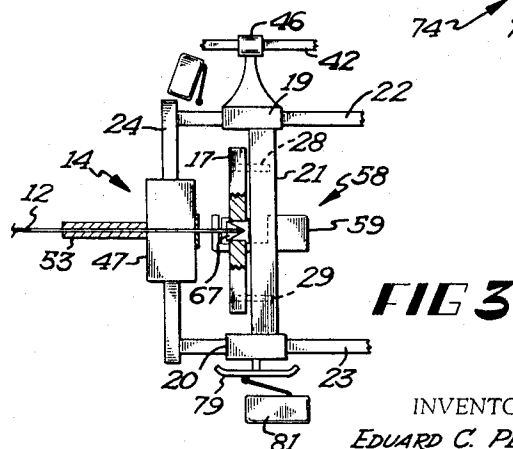
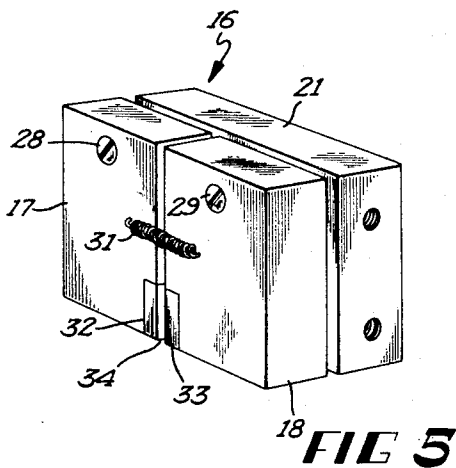
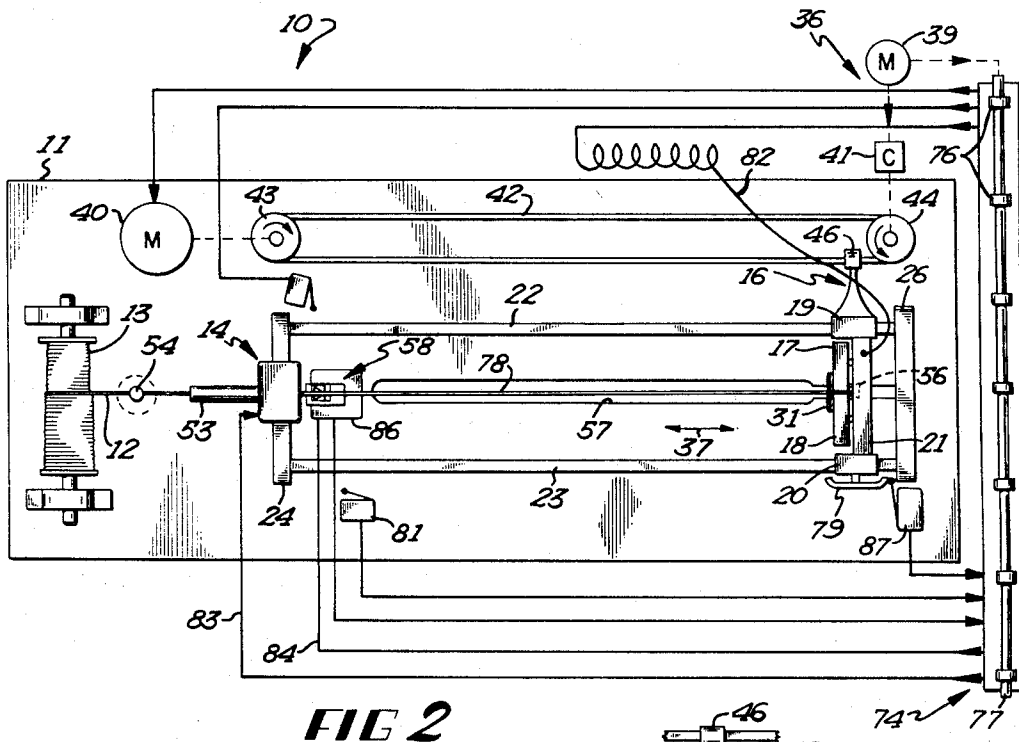
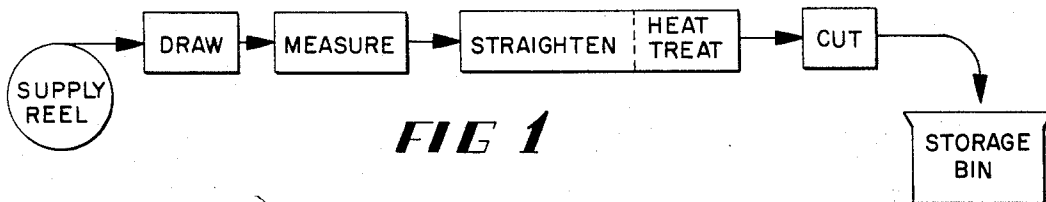
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3,401,723

NEEDLEMAKING METHOD AND APPARATUS

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2 Sheets-Sheet 1



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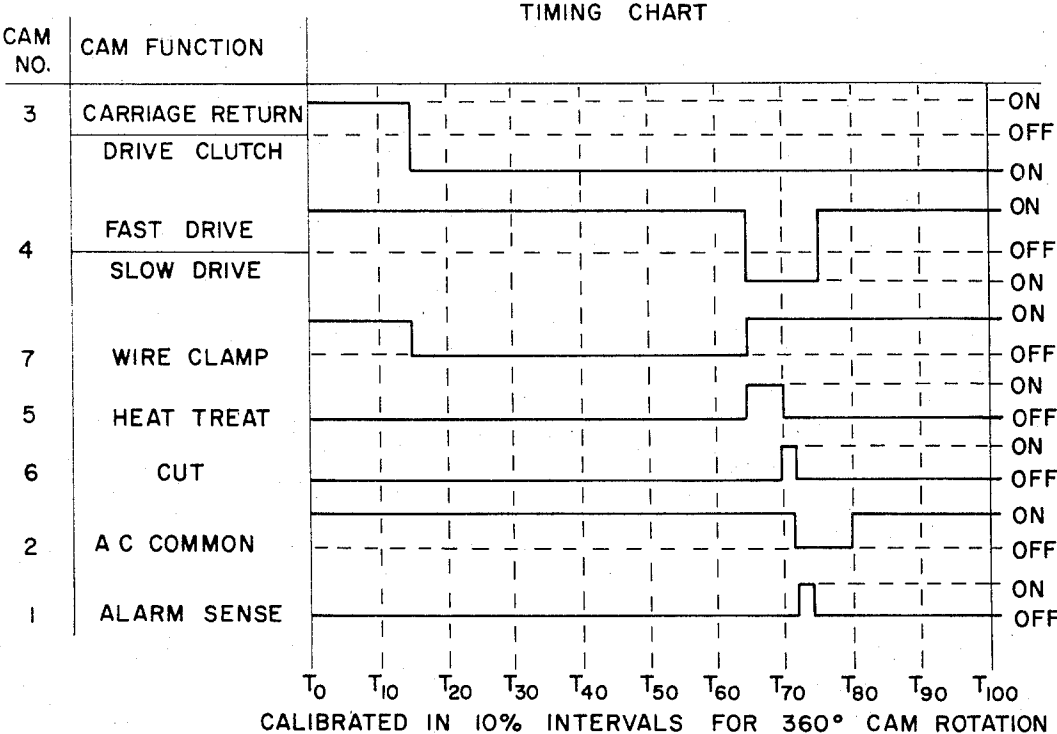
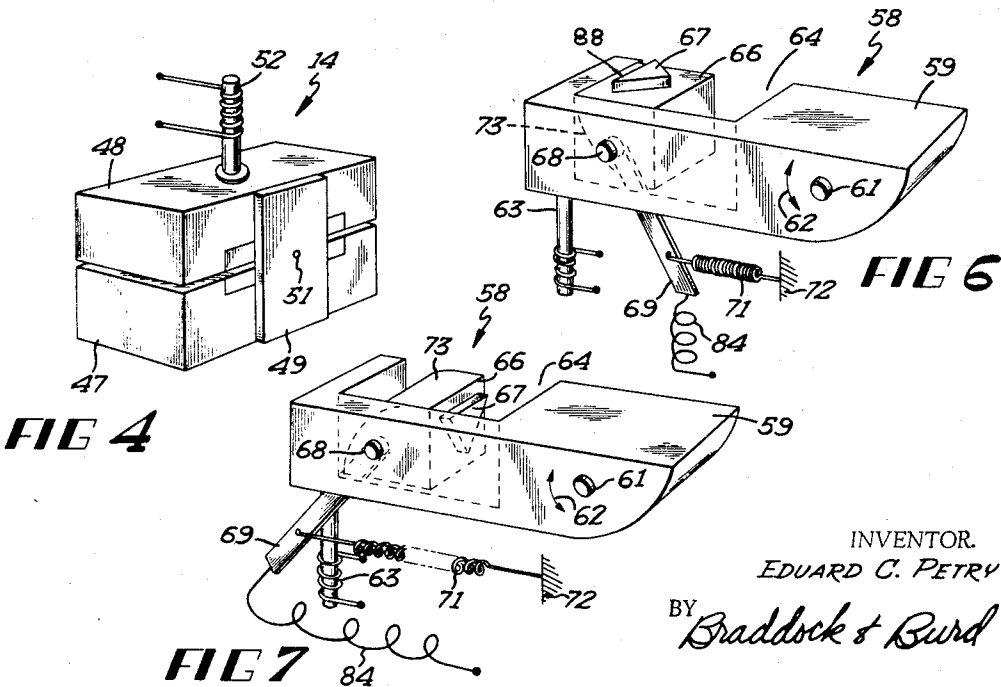


FIG 8



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**NEEDLE MAKING METHOD AND APPARATUS**  
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## ABSTRACT OF THE DISCLOSURE

A needlemaking method and apparatus having a movable carriage for drawing a wire through a clamp and guide unit. The carriage has a pair of gripping jaws which are opened by wedge shaped cams to grasp and release the wire. Near the end of the draw, the wire is heat treated and straightened under tension. The grasping cam is also a contact member which moves into engagement with the portion of the wire adjacent the clamp and guide unit. A cut voltage applied to the contact member heats the wire very hot at the point of engagement with the contact member so that the tension on the wire established by the movable carriage elongates the heated point until the wire breaks. After the wire is broken it is released from the jaws by the action of the release cam and deposited in a container.

## Summary of invention

This invention relates to a method and apparatus for automatically making linear needles usable to string drive-lines and sense-lines through a magnetic core memory plane.

Wire needles are used in the magnetic core memory art for stringing the drive-lines and sense-lines through the small openings in the rows of magnetic cores. These needles are fairly rigid and have forward tips which are rounded or bullet-nosed so as to reduce the likelihood of the forward ends from catching on the edge of one or more of the cores as the string operation proceeds. In practice, each needle is a one time article being used only for a few passes through the core matrix and then discarded. The lines are attached to the trailing end of the needle by a butt weld whereby the needle functions to thread the lines through the cores.

The method and apparatus of this invention automatically produces a large quantity of needles at a low cost in a minimum of time. These needles have the desired physical characteristics of hardness and straightness as well as a bullet-nose shape on both ends.

Briefly summarized, the invention converts ordinary fine steel wire into standard length needles having a bullet-nose shape at both ends. The apparatus handles the wire stock in five individual steps. Initially the forward end of the wire is grasped and then pulled from a supply reel. Wire is drawn through a guiding orifice to a predetermined length. Near the end of the drawing the wire is straightened by simultaneously applying tension and heat treat voltage to the wire. This straightens and tempers the wire. A cut voltage is applied to a section of the end of the wire remote from the forward end of the wire thereby severing the drawn section of the wire from the reel. The cut voltage and tension on the wire rounds the ends of the wire into a bullet-nose shape. After the wire has been cut, it is deposited into a storage location.

The apparatus has a clamp unit for guiding and applying a holding force on the wire as it unwinds from a supply reel. A carriage having a pair of movable jaws moves toward and away from the clamp unit by a drive means. An actuator located adjacent the clamp unit is operable to open the jaws to permit the jaws to grip the

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forward end of the wire projected from the clamp unit. The drive means moves the carriage away from the clamp unit drawing the wire in an elongated linear path. When the carriage approaches the end of its forward travel, the clamp means applies a holding force on the wire thereby placing the wire under tension. Simultaneously with the actuation of the clamp means, the actuator means functions as an electrical contact whereby the drawn section of the wire is placed in an electrical circuit. The voltage applied to the wire is sufficient to heat the wire to a dull red glow. With the wire under tension and heated it is straightened and annealed in the red glow condition. The wire is then air quenched by sharply cutting the voltage. This hardens the wire. The wire is cut by raising the actuator means into contact with the wire and applying a cutting voltage to the wire. The cut voltage is applied between the clamp unit and the actuator with the actuator on the hot side of the voltage. The result is that the wire is heated very hot but not to a melt at the point that the actuator contacts the wire. The continued tension on the wire from the outward movement of the carriage pulls the heated point out very thin until it eventually snaps leaving the broken ends with a bullet-nose shape. After the wire is cut it is released from the jaws and deposited in a storage location. The sequential operation of the drive means for the carriage, the clamp unit and actuator are under the control of a timer which automatically controls the apparatus.

In the drawings.

FIGURE 1 is a block diagram of the operation sequence of the needlemaking apparatus and method of this invention;

FIGURE 2 is a diagrammatic plan view of the needlemaking apparatus of the invention showing the wire drawing carriage in the needle release position;

FIGURE 3 is a fragmentary plan view partly sectioned of the needlemaking apparatus showing the wire drawing carriage in the wire pick up or reference position;

FIGURE 4 is a perspective view of the stationary clamp and guide unit;

FIGURE 5 is a perspective view of the wire gripping jaws mounted on the wire drawing carriage body;

FIGURE 6 is a perspective view of the jaw actuating cam;

FIGURE 7 is a view similar to FIGURE 6 showing the jaw actuating cam rotated to the non-operative position; and

FIGURE 8 shows the timing chart for the operation of the needlemaking apparatus.

Referring to the drawings, there is shown in FIGURE 1 the major steps of the needlemaking operation of this invention. Wire is drawn from a supply reel to a measured length. When the desired length of wire is reached the wire is simultaneously electrically heat treated and placed under tension to straighten the drawn length of wire. The wire is cut by an electrode which contacts the wire heating it to a temperature so that continued tension on the wire causes it to break at a desired length. After the wire is cut, it is discharged into a storage bin.

As shown in FIGURES 2 and 3, the apparatus 10 of this invention converts wire 12, as XLO Bright Music Wire, into standard 8 inch lengths or other lengths suitable for needles. The wire may have a diameter from .003 to .010 inch. The method of heat treat is applicable to high carbon ferric alloy wire which can be heated and air quenched for hardness. The apparatus is not limited to this particular wire or wire size, as other types and sizes of electrically conductive wire may be used. The wire 12 is pulled through clamp and guide unit 14 by a movable carriage indicated generally at 16 having a pair of gripping jaws 17 and 18. Carriage 16 has a pair of bearings 19

and 20 connected with a transverse upright block or body 21. Bearings 19 and 20 are slidably mounted on elongated parallel rails 22 and 23 secured at their opposite ends to transverse upright supports 24 and 26 mounted to table 11.

As shown in FIGURE 5, jaws 17 and 18 are located adjacent the forward side of block 21. A pin 28 projected through the upper portion of jaw 17 threaded into block 21 pivotally mounts the jaw on the block. In a similar manner, pin 29 pivotally mounts jaw 18 on block 21. The lower facing sides of jaws 17 and 18 are biased together with a spring 31 connected to each of the jaws below pins 28 and 29. To increase the gripping action and reduce wear, hard metal inserts 32 and 33 are mounted in the adjacent faces of the lower ends of jaws 17 and 18. The space between inserts 32 and 33 is a wire gripping area 34.

A drive mechanism indicated generally at 36 is operable to reciprocate carriage 16 along rails 22 and 23 as indicated by arrow 37. Drive mechanism 36 comprises a first electric motor 39 drivably coupled to a clutch 41. An endless chain 42 trained about sprockets 43 and 44 extends parallel to rail 22 and is drivably coupled to the output of clutch 41. A coupling 46 is used to connect the carriage to a portion of chain 42 whereby on movement of the chain carriage 16 moves along rails 22 and 23. A second electric motor 40 drivably coupled to sprocket 43 is used to return the carriage to the wire pick up or reference position adjacent the forward side of clamp unit 14.

Clamp and guide unit 14, shown in FIGURE 4, has a lower block member 47 and an upper block member 48 movably mounted on an upright plate 49. Unit 14 is electrically insulated from and mounted on table 11. The mid-portion of plate 49 has a hole 51 for guiding the wire as it moves between the upper and lower members. A solenoid 52 connected to upper member 48 operates to move the upper member toward and away from the lower member to hold and release the wire between the members 47 and 48. As shown in FIGURE 2, an elongated tube 53 extends from clamp and guide unit 14 toward spool 13. Tube 53 coacts with the hole 51 in the plate 49 to guide the wire 12 straight between upper and lower members 47 and 48. Located between tube 53 and spool 13 is a wire cleaning unit 54, as a wick saturated with alcohol. Returning to FIGURES 2 and 3, with the jaws 17 and 18 in gripping engagement with the forward end of wire 12, movement of the carriage 16 away from clamp unit 14 draws the wire through the clamp unit toward the forward or remote end of the apparatus. After measuring, heat treating and cutting the wire, the carriage 16 approaches support 26 and jaws 17 and 18 engage a wedge shaped cam 56 secured to table 11. As the jaws move over the cam they are spread or snapped open allowing the needle which has been previously cut to drop through a delivery slot 57 in the table 11 into a storage bin located below the table.

As soon as the needle has been released from jaws 17 and 18 carriage 16 returns to its initial or reference position adjacent the forward side of clamp and guide unit 14. As the carriage 16 approaches the clamp and guide unit 14 jaws 17 and 18 engage an actuator indicated generally at 58 which operates to open the jaws allowing them to grip the forward end of the previous cut wire 12 projected from the clamp and guide unit 14.

As shown in FIGURE 6, actuator 58 comprises an arm 59 having a transverse pin 61 at one end thereof pivotally mounting the arm on table 11. Arm 59 moves in up and down directions as indicated by arrow 62 about the axis of pin 61. A solenoid 63 connected to the end of arm 59 opposite the transverse pin 61 is operable to raise and lower arm 59. One side of arm 59 has a rectangular cut out or groove 64 providing a space for a block 66 carrying a wedge shaped cam 67. A transverse pin 68 pivotally mounted block 66 to the side of arm 59 thereby holding the block in cut out 64. Secured to and projected downwardly from block 66 is an elongated finger 69 connected to one end of a coil spring 71. The other end of

spring 71 is connected to a support 72 thereby biasing block 66 against the outer wall of the arm 59 positioning wedge cam 67 in the horizontal plane of the top of the arm. As shown in FIGURE 7, block 66 has an arcuate back 73 which allows the block 66 to rotate about pin 68 against the biasing force of spring 71 moving the wedge shaped cam 67 downwardly into cut out 64. With cam 67 in cut out 64 the wire gripping jaws move over back 73 and do not jam against backside 88 of cam 67.

The operation of the needlemaking apparatus 10 is under the control of a timer, indicated generally at 74, which consists of an array of seven rotating cams 76 mounted on a common motor driven shaft 77. The cams sequentially operate switches (not shown) which control electrical circuits to the motors 39 and 40, solenoid 52 and 63, as well as the wire heat treatment and electrical cutting circuits. The timing chart shown in FIGURE 8 illustrates the entire operation of the timer. The horizontal time-scale is divided into ten equal parts each representing approximately 10% of the total cycle. The vertical data is the seven active cams of the timer. Cams No. 3 and No. 4 are dual functioning in that the operate switches serving to sequentially actuate the return motor 40 and the electric clutch 41 to the main forward drive motor 39 as well as switches operable to change the motors from fast to slow speeds and back again.

The wire threaded into the apparatus through tube 53 and hole 51 in plate 49 positions a portion of the wire between members 47 and 48 of the clamp and guide unit 14. A short length of wire, projects forwardly from plate 49 so that it can be gripped by jaws 17 and 18. This places the apparatus in condition for automatic operation.

The carriage 16 is driven at a fast speed back to its pick up position by return motor 40. Cam No. 3 actuates the return motor 40 and the electric clutch 41 to release the drive of motor 39. Solenoid 52 is energized by operation of cam No. 7 thereby clamping the wire between the upper and lower members 47 and 48. As carriage 16 reaches approximately the last two inches of return travel a braking cam 79 mounted on bearing 20 intercepts a switch 81 which engages the main forward drive motor 39 to brake the speed of the carriage. The momentum of the carriage is such that the forward motor only brakes the driving chain and carriage preventing the carriage from slamming into jaw actuating cam 67. The forward portion or point of cam 67 is in alignment with the wire gripping area 34 between the jaws 17 and 18 so that as carriage 16 moves toward clamp and guide unit 14 cam 67 spreads the jaws. Further movement of the carriage locates the jaws on opposite sides of the forward end of the wire projected from unit 14. As soon as jaws 17 and 18 have moved over cam 67 the spring 31 snaps the jaws shut on the forward end of the wire.

When jaws 17 and 18 are snapped shut pinching the protruding end of the wire between the jaws, return motor 40 is turned off by cam No. 3. Simultaneously cam No. 3 actuates electric clutch 41 engaging the main drive to driving chain 42 at a fast speed. Carriage 16 starts its out-board trip pulling with it the wire held by jaws 17 and 18. Cam No. 7 actuates a switch which de-energizes solenoid 52 of the clamp and guide unit 14 thereby releasing the grip on the wire so that it can be freely drawn through hole 51. Supply reel 13 is retarded by a continuous friction brake operating on the opposite shafts of the reel. This prevents the wire from unwinding when the travel of carriage 16 slows down and terminates.

As wire 12 is drawn out to nearly the desired length, cam No. 4 on the timer shifts the main drive motor voltage to slow speed. Simultaneously cam No. 7 on the timer actuates solenoid 52 forcing the plate members 47 and 48 into frictional engagement with the wire thereby putting a drag on the wire. Continued forward movement of the carriage places the wire under tension. At the same time, cam No. 5 on the timer applies the heat treated voltage,

for example 22 volts, to the drawn wire. The circuit is completed with lines 82 and 83 connected to the carriage and clamp and guide unit 14 respectively. The flow of current through the needle portions 78 of wire 12 heat treats the wire by elevating the temperature of the wire to a dull red glow. With the wire under tension the heating takes all curvatures out of the wire providing a straight linear needle and provides the needle with a gun bluing oxide coat which is a rust inhibitor.

Cam No. 5 operates to cut off the heat treat voltage while cam No. 6 applies the cut voltage to line 84 connected to the finger 69 of the actuator 58. Cam No. 6 also actuates the solenoid 63 which rotates the actuator arm 59 in an upward direction forcing the rearward transverse edge 88 of the wedge shaped cam 67 into physical contact with the portion of the wire projected forwardly from plate 49. Solenoid 52 of clamp unit 14 is still energized and the drive motor 39 is still driving at a slow drive speed. A cut voltage is applied between the cam 67 and an AC common ground connected to clamp plates 47 and 48. The hot side of the cut voltage is on cam 67 so that the wire is heated very hot at the point of contact with the cam. The continuing tension on the wire from the drive mechanism 36 pulls the heated point out very thin until it eventually snaps. The result is that both ends of the broken wire have acquired a bullet-nose shape.

Cams No. 2 and No. 6 disconnect the cut voltage from the AC common ground. Simultaneously cam No. 1 turns on an alarm sense voltage which tests for ground voltage between a brass plate 86 located adjacent the actuator 58 and clamp unit 14. If the wire is properly cut its rear unclamped end will contact the plate establishing a circuit. If for any reason the cut was not accomplished or if the jaws 17 and 18 do not grip and draw out a wire, the circuit will not be completed and an alarm will sound causing the apparatus to stop. Once the apparatus has stopped due to failure of an operation, it will remain idle until the operator restarts it after correcting the fault.

Once the apparatus has established a successful cut cam No. 4 returns the main drive motor to the fast drive speed. Carriage 16 continues its outward travel until it strikes the needle release cam 56 which opens jaws 17 and 18 allowing the needle to drop through slot 57 in the table into a storage bin. At the same moment, carriage 16 encounters synchronizing switch 87 which serves to deactivate the electric clutch 41 in case carriage 16 is not synchronized with the other components of the machine. If carriage 16 is ahead of the timer, it will be delayed until a lobe on cam No. 3 engages the return cam drive switch starting the cycle over again.

In terms of a method of making needles from metal wire the invention includes the steps of holding the forward portion of the wire with the end of the wire being free and gripping the forward end of the wire with the jaws 17 and 18 on movable carriage 16. Movement of carriage 16 draws the wire through guide and clamp unit 14 in an elongated linear path to a predetermined length. Near the end of the drawing operation the drawn wire is straightened by simultaneously applying tension and a heat treat voltage to the drawn wire. If straight pre-heat treat wire is fed into the apparatus the heat treat cycle may be omitted. The wire is drawn at a first fast speed and then at a second slow speed. The tension and heat treat voltage is applied to the wire during the slow speed drawing operation. After the wire is heat treated it is cut at a section remote from the forward end of the wire by applying a cut voltage to the wire. The wire is drawn and therefor under tension while it is being cut to provide the end of the wire with a bullet-nose shape. After the wire is cut it is deposited in a storage location.

The foregoing disclosure relates to a preferred embodiment of the invention and is intended to cover all changes and modifications which do not depart from the spirit and the scope of the invention. The invention is defined in the following claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

In the claims:

1. An apparatus for making needles from wire comprising: first means for applying a holding force on the wire, a carriage movable toward and away from the first means, second means mounted on the carriage for gripping a forward end of the wire projected from the first means, actuator means located adjacent said first means engageable by the second means to place the second means in gripping engagement with the forward end of the wire, drive means for moving the carriage away from the first means thereby drawing the wire relative to the first means, electric heat applying means for heat treating the drawn wire, electric means for heating the wire adjacent the first means, said electric means including a contact member located forwardly of the first means and engageable with the wire, and circuit means for applying a cut voltage to the contact member whereby the wire is heated very hot at the point of engagement with the contact member and the tension on the wire, established by the movable carriage, elongates the heated point until the wire breaks, and means for releasing the forward end of the cut wire from the second means, said drive means returning the carriage toward the first means after the wire has been released from the second means.

2. The apparatus of claim 1 wherein said first means includes a pair of plate members and power means for selectively holding the plate means in engagement with the wire.

3. The apparatus of claim 2 wherein said power means is a solenoid.

4. The apparatus of claim 1 wherein the second means comprises a pair of jaws, means pivotally mounting the jaws on the carriage, and means for biasing the jaws together whereby the forward end of the wire is gripped between the jaws.

5. The apparatus of claim 4 wherein the actuator means includes a wedge shaped cam engageable with the jaws to spread said jaws whereby the jaws grip the forward end of the wire.

6. The apparatus of claim 1 wherein the actuator means includes a wedge shaped cam engageable with the second means allowing the second means to move in gripping relation with the forward end of the wire.

7. The apparatus of claim 1 wherein said drive means includes a first motor for driving the carriage away from the first means and a second motor for returning the carriage to its reference position adjacent the first means, and a timer for controlling the drive means in sequence with the electric heat applying means and the electric cut means whereby the wire is sequentially drawn, straightened and heat treated, cut and released for discharge to a storage location.

8. The apparatus of claim 1 including a timer for controlling the drive means in time sequence with the first means for applying a holding force on the wire, electric heat applying means and electric cut means whereby the wire is sequentially drawn, straightened and heat treated, cut and released for discharge to a storage location.

9. The apparatus of claim 1 including motor means engageable with the actuator means for moving the actuator means into contact with the wire, said actuator means having an electrical contact for the electric cut means.

10. The apparatus of claim 1 wherein the first means and the carriage provide electrical contacts for the electric heat applying means whereby electricity is conducted through the length of wire extended from the first means to the carriage.

11. The apparatus of claim 2 wherein the means for releasing the forward end of the cut wire from the second means comprises a stationary wedge shaped cam engageable with the jaws to spread the jaws on movement of the carriage relative to the cam.

12. A method of making needles from metal wire com-

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prising the steps of: gripping the forward end of a wire, drawing the wire in an elongated linear path, straightening the drawn wire by simultaneously applying tension and a heat treat voltage to the wire and cutting the wire by simultaneously applying tension to the wire and a cut voltage to a section of the wire remote from the forward end of the wire whereby the wire is heated very hot at said section and the tension on the wire elongates the heated section until the wire breaks.

13. The method of claim 12 wherein said wire is drawn at a first fast speed and a second slow speed, said tension and heat treat voltage being applied to the wire when the wire is drawn at said second slow speed.

14. The method of claim 12 wherein the cut length of wire is deposited in a storage location.

15. The apparatus of claim 1 wherein the actuator

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means comprise a contact member movable mounted forwardly of the first means, means for moving the contact member into engagement with the wire, said circuit means applying a cut voltage to the contact member.

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