

Oct. 15, 1968 J. C. McALEXANDER, JR., ET AL 3,405,671
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SUCCESSION OF APERTURES IN AN ARTICLE
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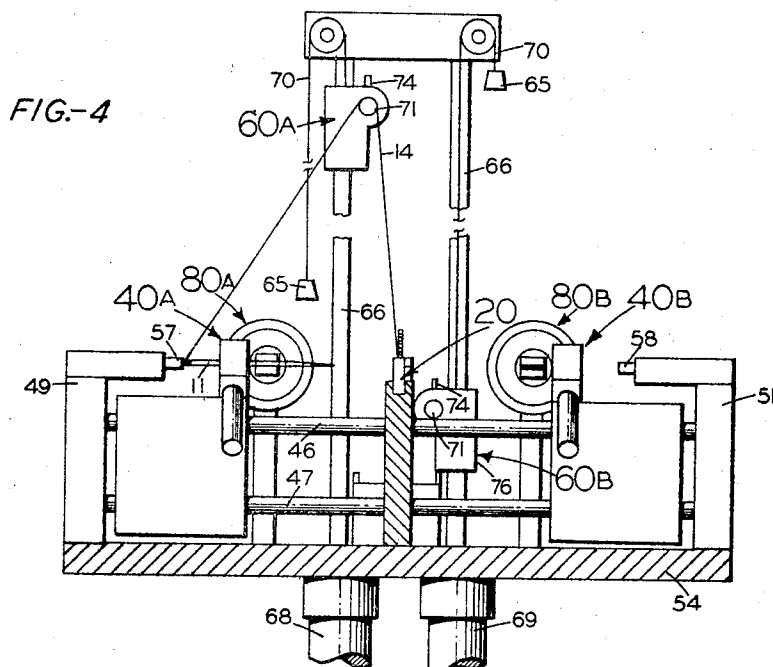
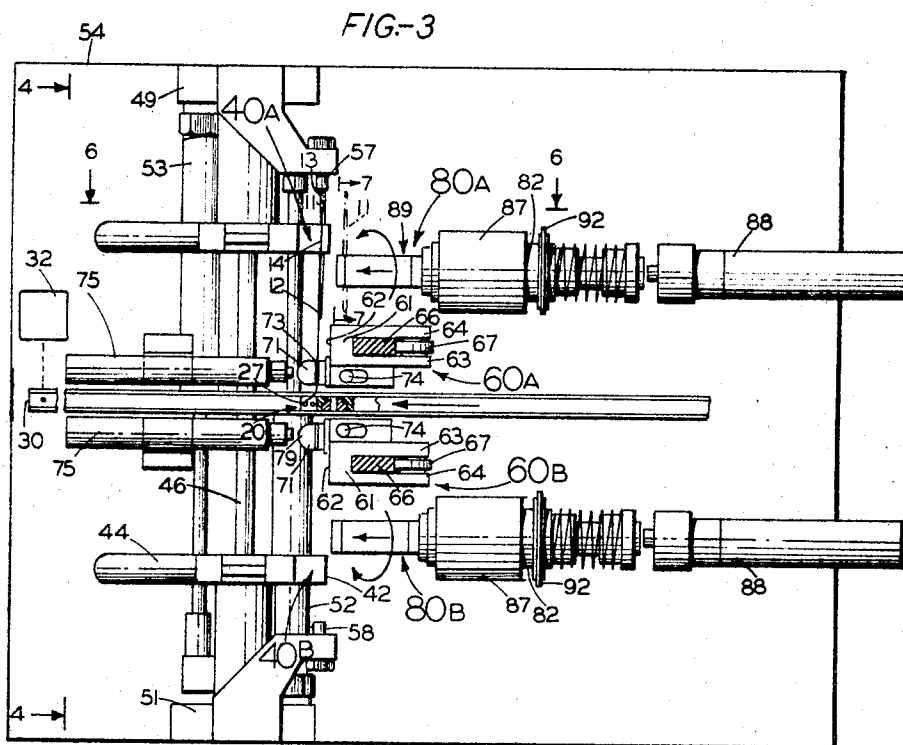
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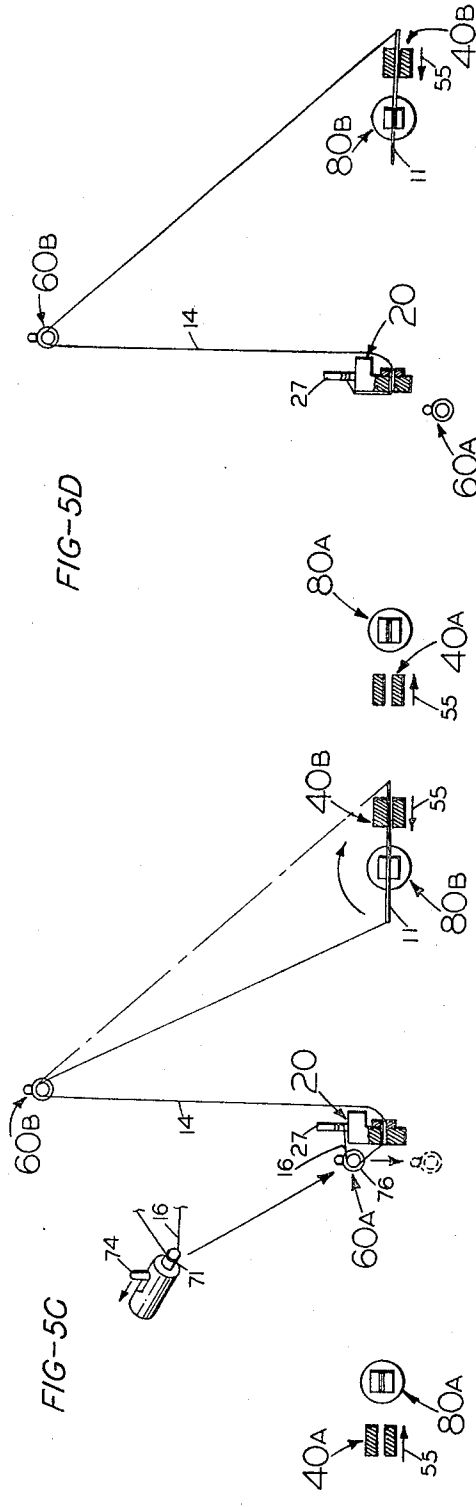
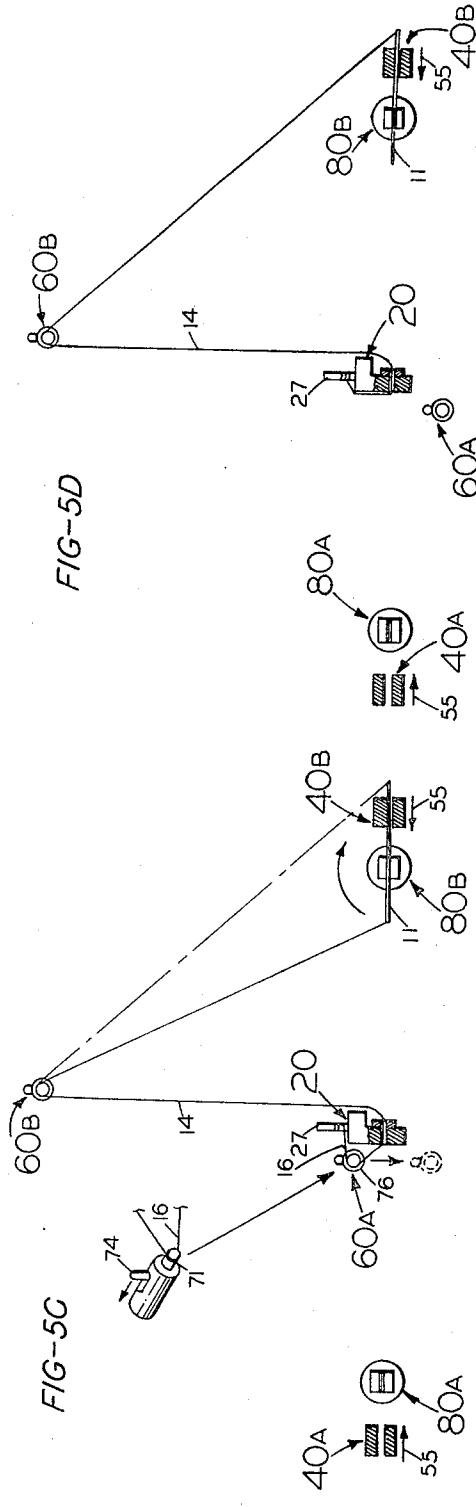
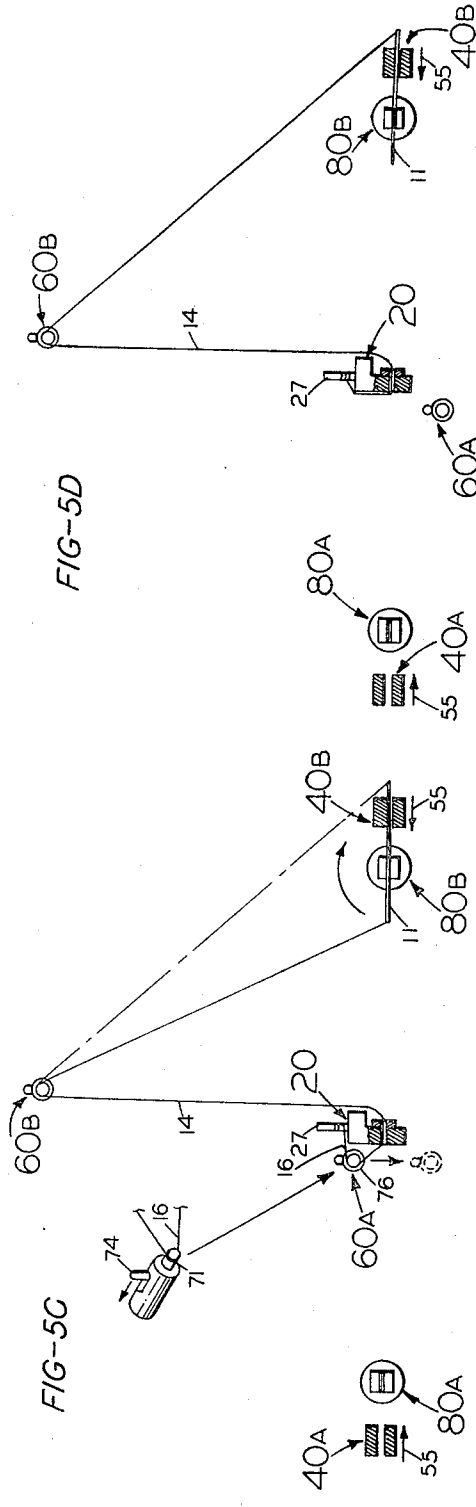
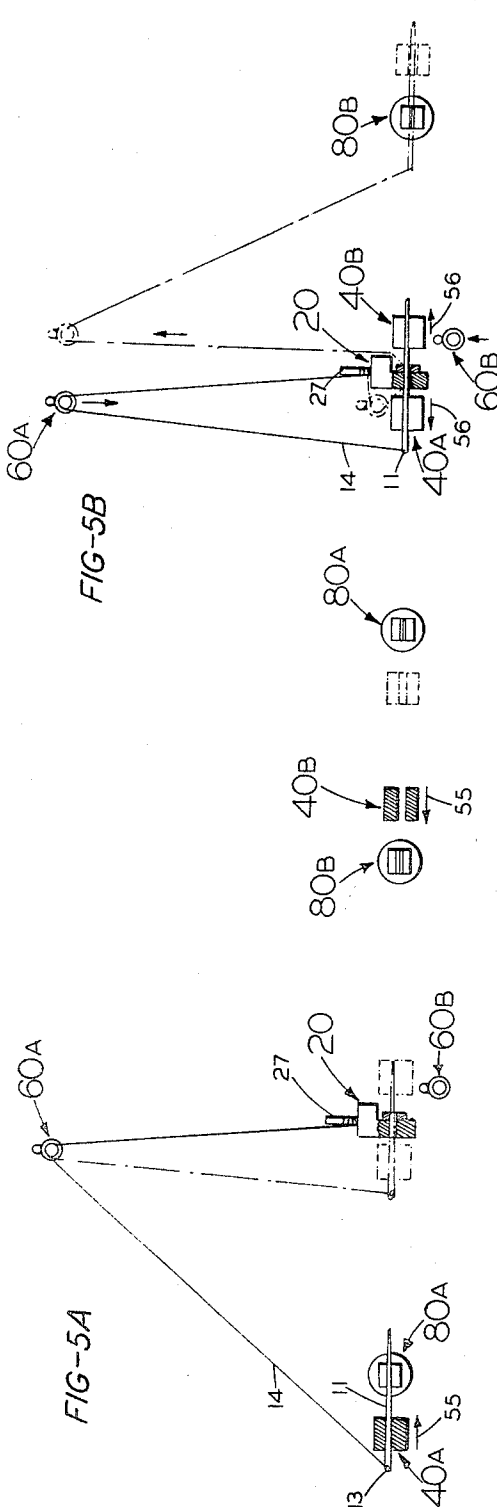
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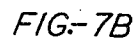
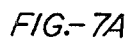
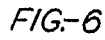
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APPARATUS FOR THREADING A STRAND THROUGH A SUCCESSION OF APERTURES IN AN ARTICLE

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ABSTRACT OF THE DISCLOSURE

An indexable article having spaced apertures there-through is threaded by passing a needle having a tensioned strand connected to the trailing end thereof back and forth through successive apertures. A first reciprocable shuttle passes the needle part-way through an aperture to a second reciprocable shuttle. The second shuttle then pulls the needle completely through the aperture where-upon the next successive aperture is indexed into position. A rotatable member then removes the needle from the second shuttle, rotates its leading end toward the article, and replaces it in the shuttle for the next successive pass.

This invention relates to apparatus for threading a strand through a succession of apertures in an article, and more particularly to weaving an insulated wire through a twister memory core stick in a sinuous manner. Accordingly, the general objects of the invention are to provide new and improved apparatus of such character.

Background

The twister is a magnetic memory element used in various types of twister memories for digital computer applications. Access to these twister elements is effected through an orthogonal array of toroidal ferrite cores. A selected number of these cores are placed side by side in a linear array such that a winding can be passed successively through adjacent cores, thus threading the entire "stick" of cores. The core sticks are composed of a non-conductive material such as phenol fiber having a row of apertures on which toroidal ferrite cores are secured by an adhesive. Two terminal posts are mounted on each end of the core sticks and in insulated wire is attached to a terminal post and weaved back and forth through the cores and stick in a sinuous manner. The weaving of the insulated wire has been a time consuming manual operation, and in order to facilitate the production of core sticks on a mass production basis it is desirable to mechanize this operation. The insulated wire which is weaved through the ferrite cores and core stick in a sinuous manner has to be weaved both ways which results in the wire crossing in each common aperture. The insulation on the first wire is often damaged when the wire passes through the core stick on the second threading operation and this results in a short circuit in the wires. Also, the wires are composed of two selected lengths which will form taut loops when weaved back and forth through the length of the core stick apertures. As the wires are weaved through the core stick the free length of wire to be pulled through the aperture is constantly diminishing. However, the free length is subject to forming kinks or knots which are detrimental to the operations of the core stick.

Other objects

Another object of the invention is to provide new and improved apparatus for weaving a wire back and forth through selected apertures in a core stick.

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A further object of the invention is to provide new and improved apparatus for weaving a selected length of insulated wire through an apertured article without damaging the insulation.

Another object is to provide new and improved apparatus for maintaining tension on the free length of wire as it is being weaved through the apertured article.

Summary

With the foregoing and other objects in view, one apparatus illustrating certain features of the invention includes a mechanism for advancing a needle, having a strand connected to the trailing end, through an aperture in an article. The needle is gripped between the releasable jaws of one of a pair of cooperating shuttles. The article is located between the shuttles and advanced to align the aperture with the shuttles so that the movement of the shuttles together will transfer the needle through the article and into the jaws of the other shuttle. The shuttles move apart, which pulls the needle and strand through the article. Next, the needle is rotated 180 degrees so that the strand is again on the trailing end with respect to the article.

In the manufacture of twister memory core sticks a select length of insulated wire is wrapped around a terminal which is mounted on one end of an apertured core stick. The core stick is positioned on an indexing conveyor and the first aperture is indexed into alignment with a pair of shuttles which are in an initial position. The free end of the wire is threaded through an eye of a needle and secured thereto. Preferably, the needle is of the conventional type which has a point at one end and an eye at the opposite end. The needle is positioned between the releasable jaws on one shuttle with the point facing the core stick and the wire is positioned on one of a pair of synchronized take-ups so that tension can be maintained on the free length of wire between the needle and the core stick. The shuttle advances the needle and wire through the aligned aperture into position between the jaws on the second cooperating shuttle and the grip on the jaws of the first shuttle is released. The jaws of the second shuttle are actuated to grip the needle and the shuttle is retracted to the initial position. The second take-up engages the wire as the needle is pulled past the take-up to assist in maintaining tension on the decreasing free length of the wire and pulls the first take-up down into alignment with the aperture in the article. A pair of rotatable gripping members are positioned adjacent to and associated with each shuttle. The gripping member associated with the second shuttle advances from the adjacent position to grasp the needle, retracts to a clear position and rotates the needle to present the point in the direction of the core stick apertures. Also, the wire is extricated from the first take-up and pulled through the aperture by the second take-up to form a taut loop. The rotatable gripping member advances back into alignment with the shuttle and positions the needle on the shuttle. The core stick is indexed to present the succeeding aperture in preparation of the next cycle.

Drawings

Other objects, advantages and features of the invention will be apparent from the following detailed description of a specific embodiment thereof, when taken in conjunction with the appended drawings, in which:

FIG. 1 is a perspective view of a core stick showing the arrangement of the cores, terminals and conductor;

FIG. 2 is a partial cross section along line 2-2 of FIG. 1 showing the insulated wire woven between the stick and cores;

FIG. 3 is a top plan view of the apparatus for advancing a needle through an apertured article, embodying the principles of the present invention;

FIG. 4 is a partial side elevational view of the left-hand portion of the apparatus, taken on line 4—4 of FIG. 3;

FIG. 5A is a schematic view showing the initial position of the shuttles, take-ups, rotatable gripping members, core stick, wire and needle in one embodiment of the invention;

FIG. 5B is a view similar to FIG. 5A, showing the position of the take-ups, wire and needle when the shuttles transfer the needle through the apertured article;

FIG. 5C is a similar view showing the position of the take-ups, wire, needle and shuttles when the rotatable gripping member rotates the needle 180 degrees;

FIG. 5D is a similar view showing the position of the shuttles, take-ups, rotatable gripping members, core stick, wire and needle in position for the next pass;

FIG. 6 is an enlarged partial rear elevational view taken on line 6—6 of FIG. 3 and showing a needle transfer shuttle and needle rotational mechanism;

FIG. 7A is an enlarged front view taken on line 7—7 of FIG. 3 and showing the initial position of the needle in the rotatable gripping member; and

FIG. 7B is a view similar to FIG. 7A, showing the needle in the 180 degree transfer position.

General arrangement

Referring now in detail to the drawings, and particularly to FIGS. 1, 2, 3, 4 and 5A—5D, the illustrative embodiment of the invention concerns apparatus for weaving an insulated wire 14 through a twister memory core stick 20 having a succession of apertures 24—24 through which the wire is threaded in a sinuous manner. The basic components of the apparatus include:

(1) A pair of cooperating shuttles 40A—40B which transfer a needle 11 with the wire 14 attached through the core stick 20;

(2) A pair of cooperating take-ups 60A—60B with movement synchronized to the movement of the needle 11 to maintain tension on the wire 14;

(3) A pair of rotatable jaws 80A—80B, one of which removes the needle 11 from one of the shuttles 40A—40B and rotates 180 degrees to reverse the direction the needle 11 is pointing and returns the needle to the shuttle; and

(4) A conveyor 30 which indexes the core stick 20 to present the next aperture 24 into alignment with the fixed reciprocating path of the needle 11.

The specific construction and operation of the various elements of the specific embodiment of the invention will now be described in detail in the following sections I to IV, after which the method of operation will be described in section V.

(I) Structure of twister memory core stick 20

Referring again to FIG. 1, the core stick 20 includes an L-shaped phenol fiber board 21 having a vertical leg 22 and a horizontal leg 23 with a row of apertures 24—24 in the vertical leg 22 and a row of corresponding indexing slots 26—26 in the horizontal leg 23. A pair of terminal posts 27—27 and a pair of associated terminal posts 28—28 are mounted at the ends of the horizontal leg 23 to serve as terminals to which a pair of the insulated wires 14—14 are attached. A plurality of toroidal ferrite cores 29—29 are attached by the use of an adhesive to the vertical leg 22 directly over the row of apertures 24—24. A first wire 14 is wrapped about one of the terminal posts 27 and woven back and forth through each of the apertures 24—24 and associated cores 29—29, and terminated by wrapping the remaining end around one of the terminal posts 28. The vertical leg 22 of the core stick 20 is slidably retained in a U-shaped conveyor trough 30 (FIG. 3). The core stick 20 is indexed by means of a pusher arm 31 which engages the indexing slots 26—26 in the horizontal leg 23 to position each of the apertures 24 in alignment with the fixed path of needle traverse. After the last aperture 24 has been

threaded the core stick 20 is indexed forward into contact with a switch 32 (FIG. 3) which stops the apparatus. Then, a second wire 14 is threaded through the apertures 24—24 in the opposite direction, as illustrated in FIG. 2.

(II) Structure of shuttles 40A—40B

Referring to FIGS. 3 and 6, the shuttles 40A—40B are composed of a lower fixed jaw 41 and an upper jaw 42 which is pivotally fixed to the lower jaw by a pin 43. The upper jaw 42 is actuated by a conventional air cylinder 44 to grasp or release the needle 11 at predetermined times. The shuttles 40A—40B are mounted for slidable movement on a shaft 46 and a shaft 47 which are secured to a support 49 and a support 51. Shuttle 40A is moved reciprocally by an air cylinder 52 (FIG. 3) and shuttle 40B is moved reciprocally by an air cylinder 53, mounted on the supports 51 and 49 respectively. The supports 49 and 51 are mounted on a base 54 which supports the illustrated apparatus.

The shuttles 40A—40B move simultaneously toward each other from an initial position 55 (FIG. 5A) to a transfer position 56 (FIG. 5B) and then move reciprocally back to the initial position 55 (FIG. 5C). The needle 11 abuts against a stop 57 or a stop 58 when the shuttles 40A—40B are in the initial position 55. This serves to preposition the needle 11 for transfer to the rotatable gripping members 80A—80B (FIG. 5C). Assuming that the needle 11 is initially loaded in the shuttle 40A at the initial position 55, the shuttles 40A and 40B are moved together to the transfer position 56 (FIG. 5B) where the needle 11 is transferred from shuttle 40A through the core stick aperture 24 into the cooperating shuttle 40B. Then the shuttles are moved apart to the position shown in FIG. 5C to draw the wire 11 through the aperture 24.

(III) Structure of take-ups 60A—60B

Referring to FIGS. 3, 4 and 5A—5D, there are shown the take-ups 60A—60B for applying tension to the free length of wire 14 located between the last threaded aperture 24 and the needle eye 13. The take-ups 60A—60B move vertically in synchronization with the movements of the needle 11. Each of the take-ups 60A—60B includes a U-shaped section 61 having a base 62 with a leg 63 and a leg 64 which are spaced for slidable movement on a vertical bar 66. A wheel 67 is mounted between the legs 63 and 64 to hold the take-up in sliding position against the vertical bar 66. A pair of counterweights 65—65 (FIG. 4) are attached to the take-ups 60A—60B respectively by means of a cord 70. The weights 65—65 pull the take-ups vertically to maintain tension on the wire 14 unless urged to move by movement of the needle 11 or by an air cylinder 68 or an air cylinder 69.

A spring-actuated plunger 71 (FIG. 6) is attached to the leg 63 of the take-ups 60A—60B to hold the wire 14 and is urged to the right, as viewed in FIG. 6 by a spring 72. The plunger 71 has a groove 73 which retains the wire 14 during vertical movement of the take-up and a bullet-shaped point 79 over which a wire loop 16 (FIG. 5C) slips when the plunger 71 is retracted. A vertical post 74 is mounted on the plunger 71 to be engaged by an air cylinder 75 (FIG. 6) when the take-up is at a needle rotation position 76 (FIG. 5C). The air cylinder 75 engages the post 74 and retracts the plunger 71 to free the loop of wire 16 retained in the groove 73. The wire 14 is precut from a spool and has a tendency to curl and knot if any slack is allowed in the wire during the movement of the wire 14 through the core stick 20. As the plunger 71 is retracted to extricate the wire loop 16, the loop diameter decreases as the wire slips off of the point 79 allowing the wire loop 16 to be pulled through the aperture 24 under tension. The adjacent take-up, under the urging of the counterweight 65, maintains tension on the wire 14 to pull the loop 16 as it slips off of the point 79 to prevent knots or kinks from forming. The

vertical bar 66 has a uniform cross section from the top down to a shoulder 78 of the bar 66. The take-ups 60A-60B are urged by the air cylinders 68 and 69 from the position 76, after the wire loop 16 (FIG. 5C) is released, to a position against the shoulder 78. The take-up 60A or 60B remains against the shoulder 78 until actuated by the air cylinder 68 or 69 to move into engagement with the wire 14.

(IV) Structure of the rotatable gripping members 80A-80B

Referring to FIGS. 3 and 6, the rotatable gripping members 80A-80B are utilized in rotation of the needle 11 to reverse the direction of travel. The gripping members 80A-80B are identical in structure and operation so that the description of one will suffice for the other. The member 80A is composed of a lower fixed jaw 81 mounted on a shaft 82 and an upper jaw 83 which is pivotally fixed to the lower jaw 81 by a pin 84. The upper jaw 83 is urged against the lower jaw 81 with a constant force provided by a spring 86. This gripping force holds the needle 11 when the needle is released by the shuttle 40A. The gripping member 80A is mounted on a bearing support 87 for slidable movement on the base 54. An air cylinder 88 moves the gripping member 80A reciprocally from an initial position 89 (FIG. 3) into engagement with the needle 11. The shuttle 40A releases the needle 11 and the rotatable member 80A retracts with the needle 11 which is depicted in phantom lines held between the jaws 81 and 83. The rotatable member 80A is rotated through 180 degrees (FIGS. 7A-7B) in the initial position 89 by a conventional drive motor (not shown) through a drive chain 91 and a sprocket 92 mounted on the lower jaw shaft 82. After rotation of the needle 11 through a 180 degree arc, the rotatable member 80A advances back into alignment with the shuttle 40A (FIG. 3) where the needle 11 is grasped and retained. The rotatable jaw 80A retracts to initial position in preparation for the succeeding cycle of operation.

(V) Operation

One end of the precut length of insulated wire 14 is wrapped around one of the terminals 27-27 mounted on core stick 20 and the other end is threaded through the eye 13 of the needle 11. The core stick 20 is then placed on the U-shaped conveyor trough 30 in a position so that the pusher arm 31 can engage the indexing slot 26 to align the first aperture 24 with the fixed path of needle traverse. The needle 11 is inserted between the jaws 41 and 42 of the shuttle 40A (FIG. 5A), with the point 12 in the direction of the core stick aperture 24, and the air cylinder 44 is actuated to firmly grip the needle 11. Also, the shuttles 40A and 40B are in the initial position shown in FIGS. 4 and 5A. The length of wire located between the terminal post 27 and the positioned needle 11 is placed over the groove 73 which is located on the plunger 71 of the take-up 60A (FIG. 5A). The take-up 60A is actuated to a vertical position to take up the slack and maintain tension on the wire 14.

The air cylinders 52 and 53 are actuated which move the shuttles 40A-40B together to the position 56 shown in FIG. 5B. The needle point 12 passes through the core stick aperture 24 and enters between the jaws 41 and 42 of the shuttle 40B. The air cylinder 44 for the shuttle 40A is de-energized, which releases the grip on the needle, and the air cylinder 44 for the shuttle 40B is energized to grip the needle. The air cylinders 52 and 53 are activated to return the shuttles 40A-40B to the initial position 55, which is the position illustrated in FIG. 5C. As the shuttle 40B returns to the initial position 55, the needle 11 and attached wire 14 are pulled through the aperture 24 and the core 20. Also, the air cylinder 69 is actuated to push the take-up 60B upwards with the plunger 71 engaging the wire 14 to maintain tension and pull the other cooperating take-up 60A down to the position 76 (FIG. 5C). When the take-up 60A is pulled down

into alignment with the aperture 24 the air cylinder 75 is actuated to retract the plunger 71 and extricate the wire loop 16. The take-up 60B which maintains tension on the wire 14 pulls the loop 16 through the aperture 24 as the plunger 71 is retracting (FIG. 5C) to prevent knots or kinks from forming.

As the take-ups 60A and 60B maintain tension, the rotatable gripping member 80B is advanced (FIG. 5C) to the left (FIG. 3) into engagement with the needle 11 by actuation of the air cylinder 88. The air cylinder 44 is deenergized and the upper jaw 42 relaxes allowing the rotatable gripping member 80B to grasp the needle 11 and retract to a position clear of the shuttle 40B. The rotation drive motor (not shown) is actuated and the drive chain 91 rotates the needle 11 to the 180 degree position (FIG. 7B), and the needle point 12 again faces in the direction of the core stick 20. The air cylinder 88 for the gripping member 80B is actuated which advances that member into alignment with the shuttle 40B and pushes the needle 11 between the shuttle jaws 41 and 42. The air cylinder 44 for the shuttle 40B is then actuated and pivots the upper jaw 42 to firmly grasp the needle 11. The rotatable gripping member 80B is next retracted clear of the shuttle 40B by the air cylinder 88.

The core stick 20 is indexed to present the succeeding aperture 24 into alignment with the fixed needle traverse path, and the above operations are repeated until the wire 14 is woven through all of the apertures 24 and cores 29. The wire is released from the needle 11 and wrapped one of the terminals 28-28. The end of another precut length of insulating wire 14 is wrapped around the other terminal 27 and the other end is threaded through the eye 13 of the needle 11. The core stick 20 is then replaced on the U-shaped conveyor trough 30 and the above sequence of operations is repeated to weave the wire 14 in the opposite direction to complete the memory core stick 20 wiring operations.

It is desirable that the needle be of small cross section with a point on one end and an eye located on the trailing end of the needle as it advances through the aperture. The area of each aperture is limited and weaving the insulated wire in the opposite direction results in the wires crossing in the aperture. To prevent damage to the insulation the cross section of the needle must be as small as possible to result in a minimum of rubbing. The wire is attached at the trailing end of the needle through the eye so that the cross section of the eye and wire is no greater than the cross section of the preceding portion of the needle. This requires a needle with the area surrounding the eye being reduced to compensate for the area of the attached wire.

It is to be understood that the above-described embodiment is merely illustrative of the principles of the invention and that other embodiments may be devised by persons skilled in the art which embody these principles and fall within the spirit and scope of the invention.

What is claimed is:

1. Apparatus for threading a strand through a succession of apertures in an article, which comprises:

- a needle having a leading end, and a trailing end to which the strand is connected;
- a pair of spaced shuttles, each having releasable jaws for gripping the needle;
- means for selectively actuating the shuttle jaws to grip and release the needle;

means for advancing the article between the shuttles to present the apertures one at a time to a threading position aligned with the shuttles;

means for moving the shuttles toward each other and then apart each time an aperture is moved to the threading position, the shuttle-moving means and the jaw-actuating means being so arranged that a first shuttle carrying the needle pushes part of the needle through the aperture as the shuttles move together, after which the jaws of the second shuttle close and

those of the first shuttle open so that the needle is gripped solely by the second shuttle, after which the shuttles move apart so that the second shuttle draws the needle and strand through the aperture;

a pair of rotatable gripping members mounted on opposite sides of the article and associated one with each shuttle, each having jaws designed to grip the needle;

means for transferring the needle from a shuttle to the associated gripping member after each pass;

means for rotating that gripping member 180° to reverse the direction of the needle; and

means for transferring the reversed needle back to the shuttle in preparation for the next pass.

2. Apparatus as defined in claim 1, which further includes:

means including a pair of yieldable take-ups each having a retractable strand engaging projection thereon and mounted one on each side of the advancing article for perpendicular reciprocatory movement relative to the article and to the reciprocable shuttles for applying tension to a free length of strand extending at any time between the article and the needle;

means rendered effective prior to each threading step for moving the retractable strand engaging projection of the first take-up associated with the needle-carrying shuttle into engagement with the free length of strand extending between the article and the needle to draw the strand into a taut loop clear of the path of movement of the shuttle whereupon the take-up moving means exerts a force tending to lengthen the loop such that the take-up shifts position in response to the position of the needle;

means rendered effective after the needle has been transferred to the other shuttle for moving the retractable projection on the second take-up in the same manner as previously set forth to take-up the strand on the other side of the article;

means for moving the second take-up to exert a force tending to draw the strand into a taut loop over the retractable projection of the second take-up, the movement of the second take-up transmitting a force along the strand to initiate and maintain movement of the first take-up in the opposite direction until the tensioning force on the first take-up is released; and

means rendered effective upon the release of tension on the first take-up to retract the projection thereof from the strand.

3. Apparatus for threading a wire in a sinuous loop through a succession of regularly spaced apertures in an article, which comprises:

a track;

means for advancing the article intermittently along the track in a succession of steps to present the apertures one at a time to a threading position;

a needle having a point at one end and an eye at the other, one end of the wire being connected to the article and the other to the eye of the needle;

a pair of spaced shuttles, each having releasable jaws designed to grip the needle, the shuttles being mounted on opposite sides of the article in alignment with an aperture in the threading position;

means for selectively actuating the shuttle jaws to grip or release the needle, the needle being initially carried by a first shuttle with the point facing the aperture to be threaded;

means for moving the shuttles relatively together and, after a dwell, back apart so that the first shuttle pushes part of the needle through the aperture to a position where it can be gripped by jaws of the second shuttle, at which time the jaws of the second shuttle close to grip the needle and the jaws of the first shuttle open, after which the shuttles move apart

and the second shuttle draws the needle and a portion of the wire through the aperture;

yieldable take-up means for applying tension to the variable free length of wire extending between the article and the needle at all times;

a pair of rotatable gripping members mounted on opposite sides of the article and associated one with each shuttle, having jaws designed to grip the needle;

means for advancing a selected one of the gripping members into engagement with the needle after each pass and, after a dwell, for retracting the gripping member, the shuttle jaws being opened during the dwell period to release the needle to the gripping member; and

means for rotating the gripping member carrying the needle 180° after transfer of the needle to turn the needle so that the point again faces the article, after which the means for advancing and retracting the gripping member is again actuated and the shuttle jaws are reclosed to transfer the needle back to the same shuttle, after which the article is indexed one step along the track in preparation for the next pass, whereby the strand is threaded back and forth through the apertures in a sinuous loop maintained taut by the take-up means.

4. Apparatus as recited in claim 3, wherein the jaws of the gripping members are spring biased to closed needle-gripping positions, the gripping surfaces being tapered to permit entry of the needle between the jaws to a gripping position as the gripping member is moved into engagement with a needle positively held by the associated shuttle.

5. Apparatus as recited in claim 3, wherein the yieldable take-up means comprises:

a pair of take-ups mounted on opposite sides of the article and associated one with each shuttle, each take-up having a linear movement transverse to the path of shuttle movement to engage the wire;

each take-up having a retractable projection extending across the needle transfer path;

the retractable projection having a groove in alignment with the transfer path to engage and retain the wire during movement;

the retractable projection having a bullet-nose shape from the groove outward to allow the wire to slide off when the projection is retracted;

means for providing an initial selective movement of either one of the take-ups for initial engagement and tensioning of the free length of wire when the needle transfers from one shuttle to the associated shuttle; and

means for retracting the projections.

6. Apparatus as recited in claim 5, wherein:

support members are provided for mounting the take-ups for linear movement in a vertical plane;

each take-up is provided with a resilient wheel which presses against the support member to allow a smooth sliding movement of the take-up along the support member; and

the means for providing selective movement of the take-ups and the means for retracting the projections cooperate (1) to move the first take-up into engagement with the wire and away from the article to draw the wire into a taut loop clear of the path of movement of the shuttle, the first take-up maintaining tension on the wire while the needle is transferred through the article to the corresponding shuttle, (2) to move the second take-up into engagement with the wire to maintain tension in pulling the wire through the article and forcing the first take-up down into alignment with the article, (3) to retract the projection on the first take-up to extricate the wire looped around the groove on the projection while the rotatable gripping member rotates the needle 180 degrees, the length of the wire loop which is ex-

tricated from the projection being pulled taut by the second take-up, and (4) to move the take-ups from the wire extricating position to a disengaged position in preparation for the next cycle.

7. In an apparatus for stringing a strand through a permeable article:

a pair of shuttle means each having a releasable first device for gripping a needle holding a strand;
means mounting said shuttles for reciprocating movement toward each other to advance the needle through an interposed permeable article;

means rendered effective upon movement of said shuttles toward each other for transferring the needle from one gripping device to the other to move the needle through the interposed permeable article;

a pair of reversing means, each having a second releasable needle gripping device;

means mounting said reversing means for (1) reciprocating movement toward and away from the needle advanced through said permeable article to transfer the needle to the second gripping device and then

back to the first gripping device and for (2) rotary movement to reverse the needle into position to move back toward the permeable article;

means for periodically reciprocating both of said shuttles to cyclically move the needle from one shuttle through the permeable article to the other shuttle; and

means rendered effective upon each complete reciprocation of said shuttles for alternatively operating the reversing means associated with the shuttle gripping the needle to grip said needle and to rotate said needle while said needle is gripped by the second gripping means.

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