

[54] WIRING LOOM

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[51] Int. Cl.H05k 13/04
[58] Field of Search.....29/203 MM, 203 MW, 203 B, 203, 29/208

[56] References Cited

UNITED STATES PATENTS

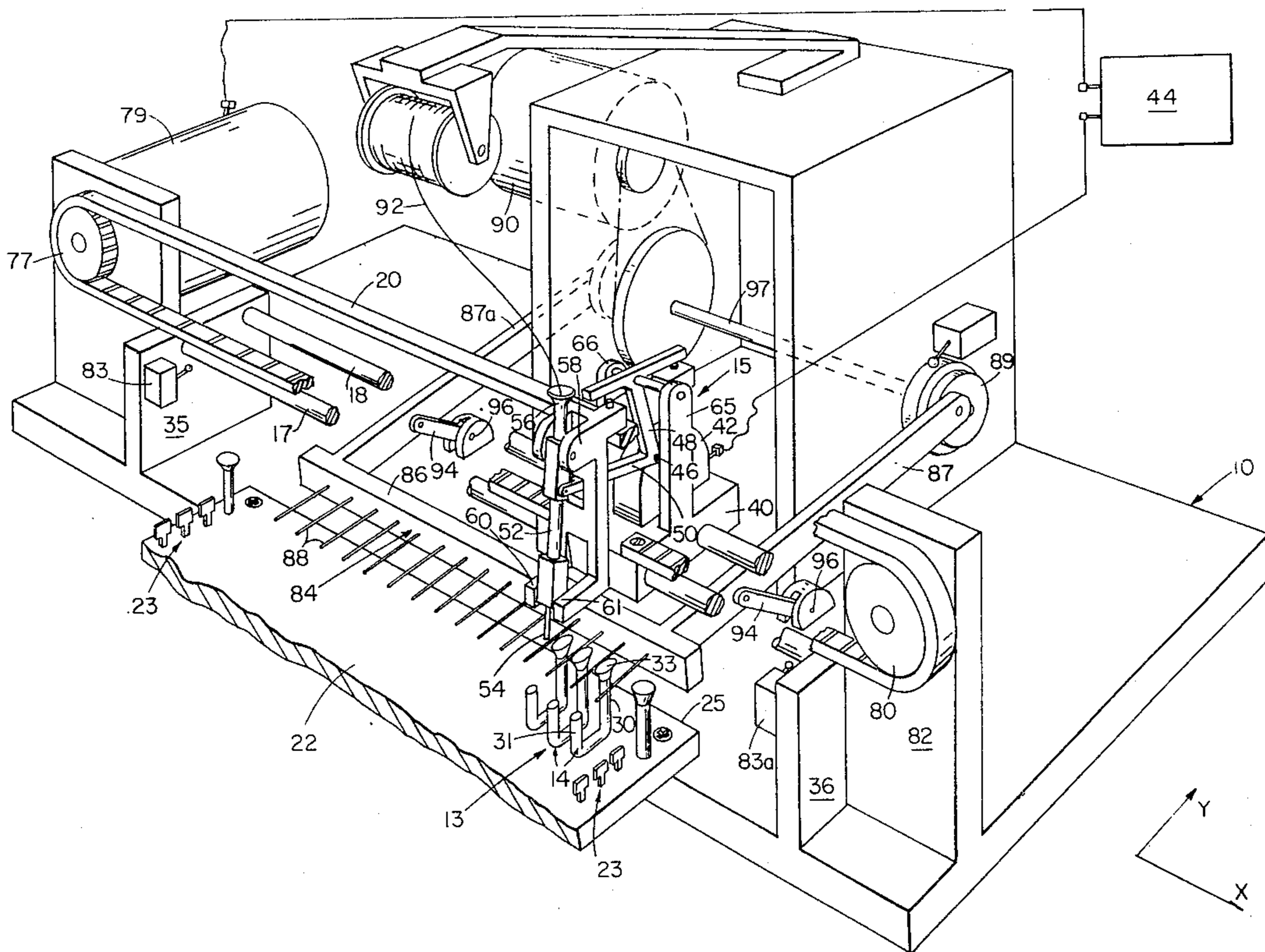
2,978,800 4/1961 Blain.....29/203 MM
3,324,443 6/1967 McFadden et al.29/203 MW X

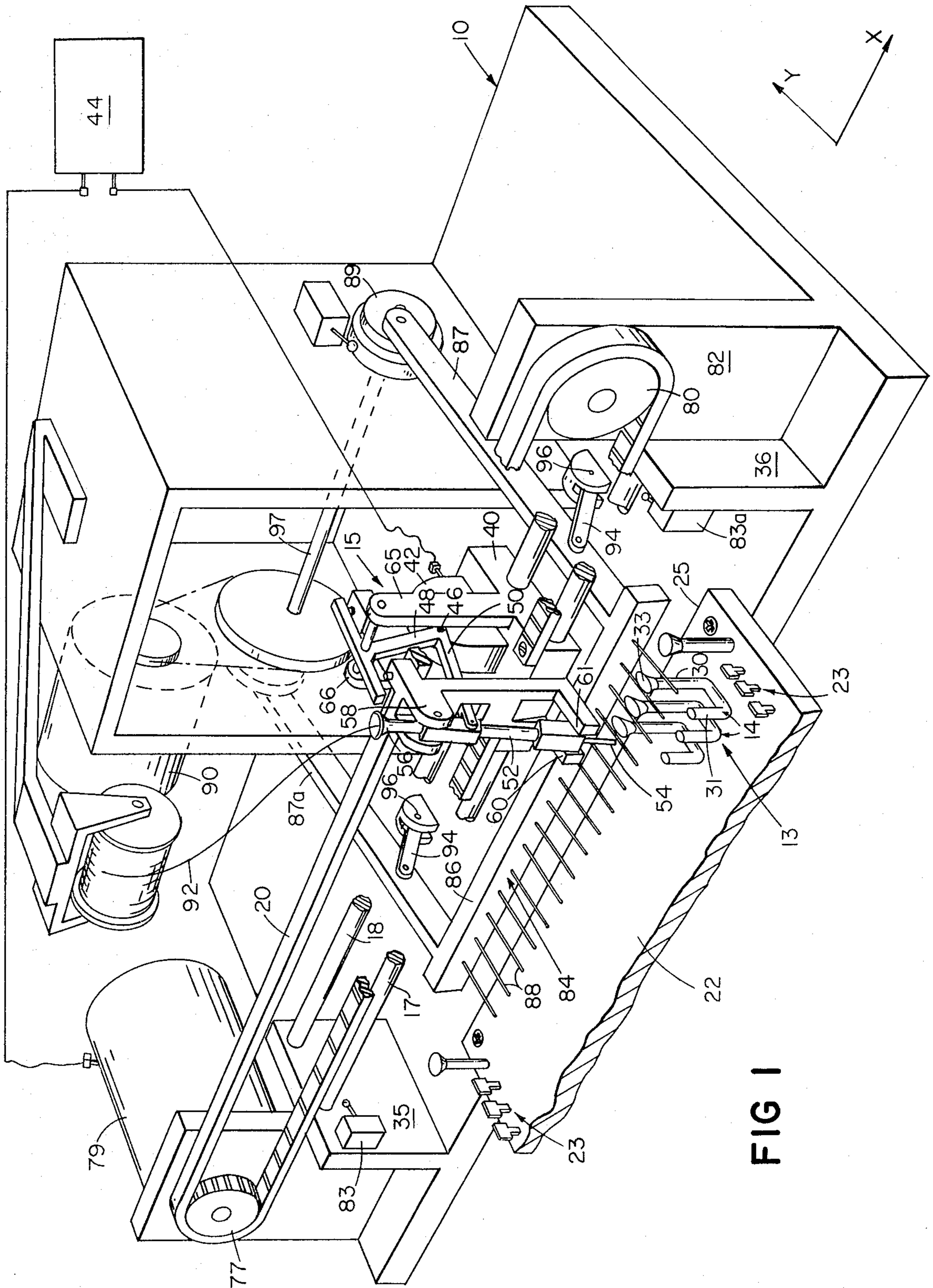
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[57] ABSTRACT

An automatic wiring loom in which a row of core posts is held on a stationary base in horizontal alignment with a track, a wire laying head is movably mounted on a track and includes a carriage rotatably supporting a threading arm carrying wire to be woven, connected to an electrically operated solenoid for displacement of the arm in a plane normal to the row of core posts between a first position in which the arm is spaced inwardly from the side of the row of core posts adjacent the track, and a second position in which the arm is spaced outwardly from the opposite, outer side of the row of core posts, a motor driven timing belt is operatively associated with the wire laying head for effecting reciprocal movement along the track and control means are connected to the solenoid to reciprocally move the arm between the first position and the second position to weave wire around portions of said posts in a predetermined pattern to form a computer matrix.

6 Claims, 4 Drawing Figures





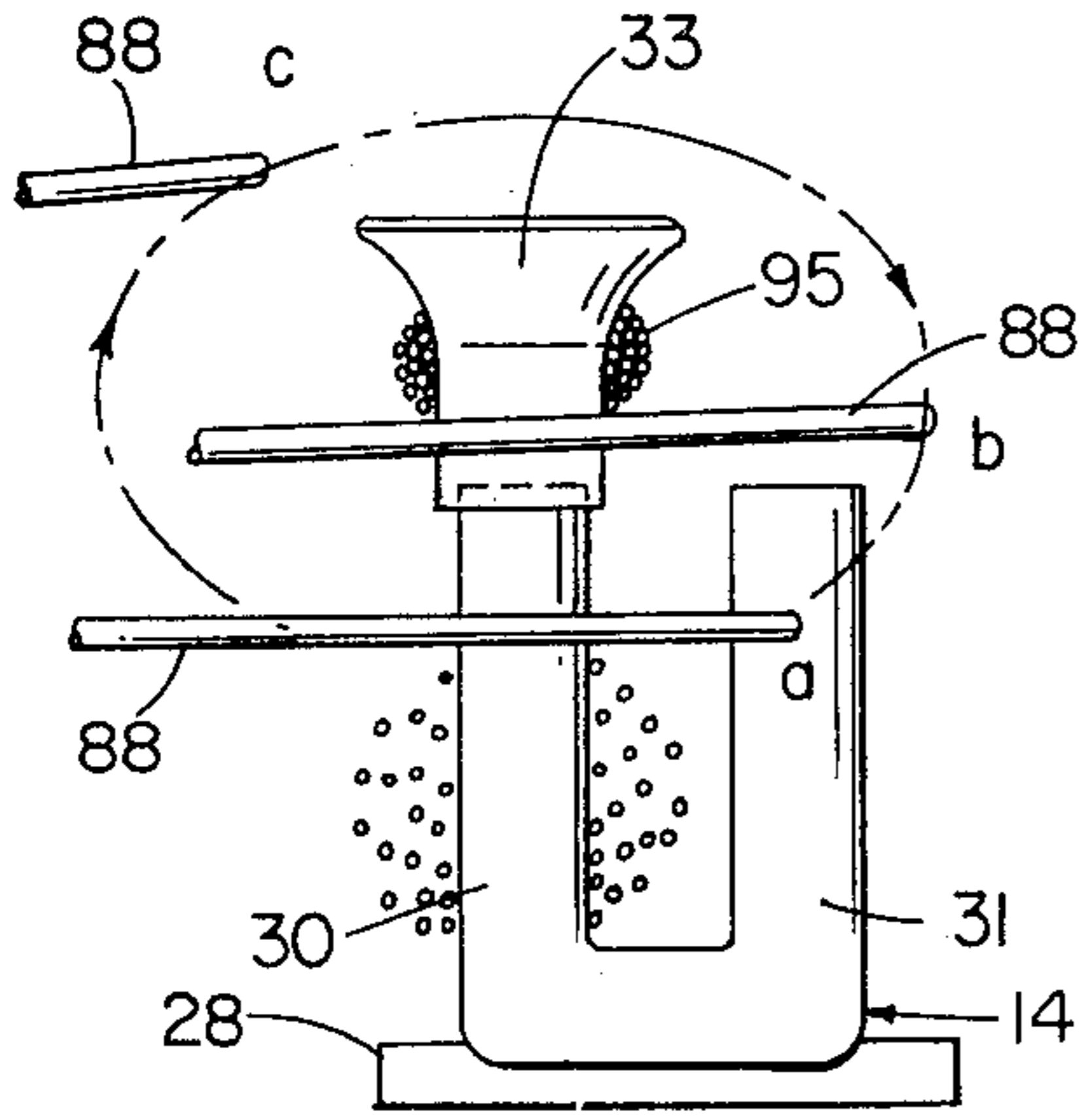


FIG 5

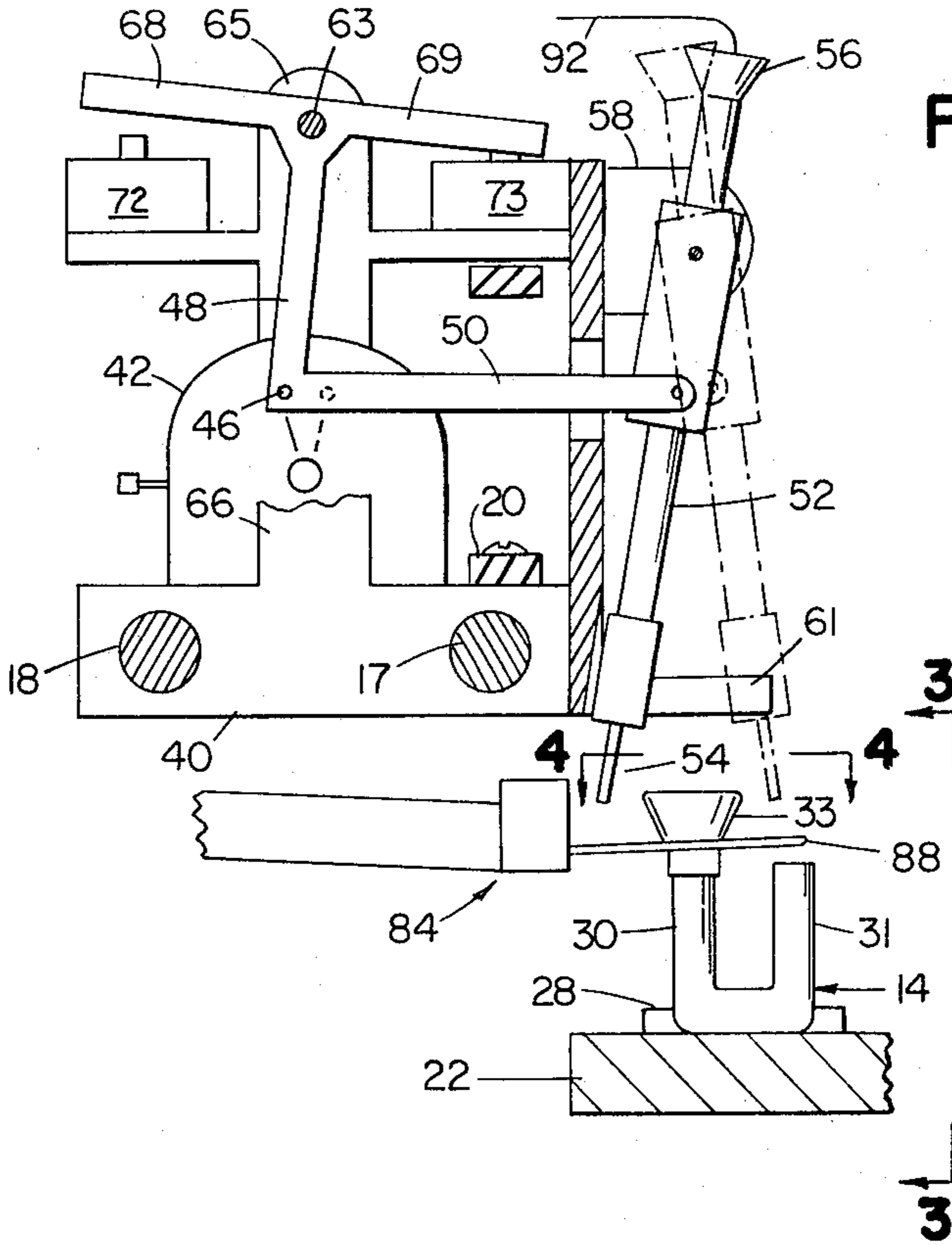


FIG 2

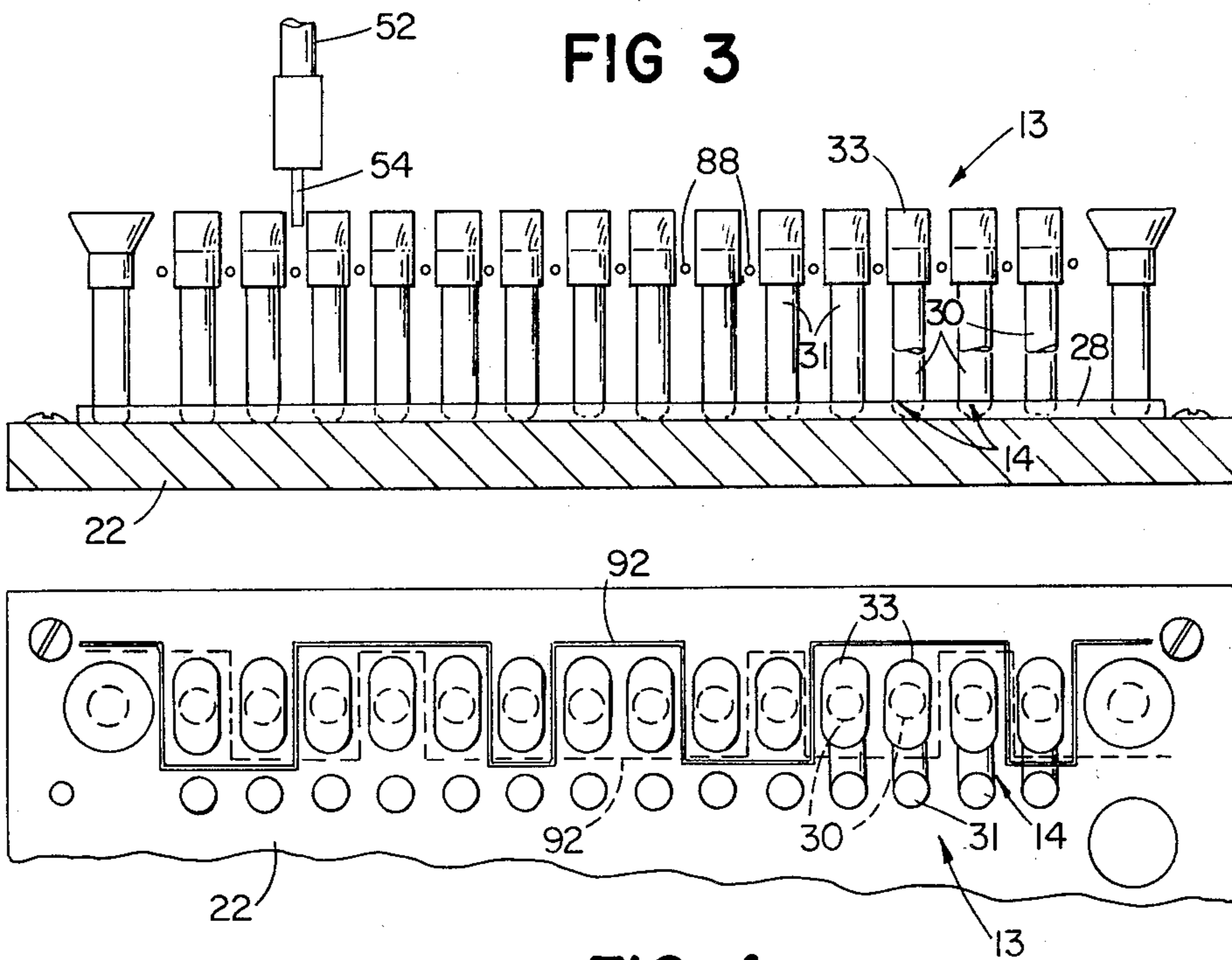


FIG 3

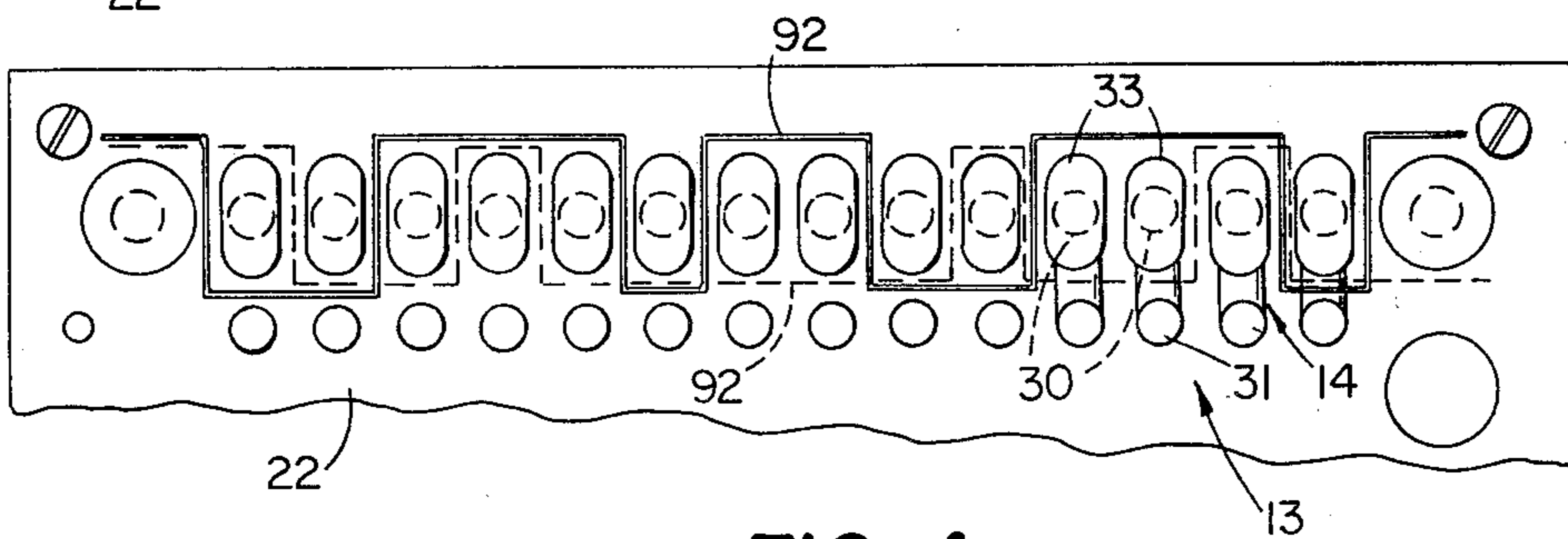


FIG 4

WIRING LOOM

This invention relates to controlled winding of wires around a series of core posts in predetermined patterns.

In recent years, woven wire matrixes have been used as memory elements in electronic computers. These memory elements are generally formed manually by weaving continuous insulatably coated conductors around a series of closely spaced core posts in given patterns to form a complex woven wire matrix. The wire, being thin, is difficult to manipulate, and where the number of closely spaced posts is large (i.e., 40), manual weaving is time consuming and produces occasional weaving errors due to the intricacy of the required weaving pattern. Such weaving errors are troublesome as they are difficult to detect and expensive to correct. Further, if undetected, these weaving errors introduce undesirable errors in the computer output. Consequently, there exists a need for a mechanical weaving device capable of rapidly weaving wire matrixes in an accurate manner.

Moreover, as computers use a variety of memory elements, each comprising a different wire matrix, the weaving device must not only be accurate but flexible (i.e., capable of weaving a variety of wiring patterns). It has been especially difficult to meet the dual requirements of uniformity of product and flexibility of product pattern in high-speed production systems.

Accordingly, it is a primary object of the invention to automatically control the weaving of wires around magnetic core memory posts by mechanical means in uniform predetermined patterns in an accurate, rapid manner. Other objects are to detect wiring errors as they occur during weaving, and to avoid tangling of wires during weaving.

These and other objects of the invention are uniquely accomplished in the preferred embodiment by providing an automatically controlled wiring loom having a stationary base for supporting a plurality of upwardly projecting core forms fastened to a memory element having a plurality of electrodes, the core forms being sequentially arranged horizontally in a row, tubular tracks positioned parallel to the row of core forms, being spaced rearwardly therefrom for slideably supporting wire laying means connected to traverse means and electronic control means for winding wire around the core posts in predetermined patterns. Preferably the wire laying means includes a carriage member pivotally supporting a threading arm having a feed tube carrying wire to be wound around the core forms, an electrically operated rotary solenoid linked to said arm and connected to a remotely located automatic control means for operating the threading arm and a rocker attached to the top of the threading arm for making and breaking switches connected with the control means for detecting weaving errors.

Also, the traverse means preferably includes a timing belt driven by a stepping motor, also connected to the automatic control means, attached to the carriage member of wire laying means for effecting reciprocal movement along said track in a transverse horizontal direction parallel to said row of core forms.

In another respect, the invention features a comb pivotally mounted adjacent and parallel with said row of core forms, having pins extending perpendicularly and horizontally between mandrels provided on the top of each core form and connected by linkage to drive means, all for controlling the stacking of wires wound on the core forms.

Wire weaving is accomplished by threading the free end of a continuous wire through the feed tube of the wire laying means, the other end of the wire being fastened to an electrode on the memory element and actuating the automatic control means to cause the traverse means to displace the carriage laterally along the track in a given direction (i.e., the X-axis) and to cause the solenoid to periodically move the weaving arm accurately and transversely toward or away from the row of core posts (i.e., in the Y-axis) between a given pair of core posts, to weave the wire around the series of core posts in a pattern determined by input (i.e., punched cards or mag-

netic tape) supplied to the automatic control means. Once the carriage has traversed the entire row of core posts, the wire is cut and attached to a second electrode. The free end of the remaining wire extending from the feed take is attached to a third electrode and the movement of the carriage is reversed to continue weaving in the opposite direction.

Periodically the comb is manually cycled through a generally elliptical path by drive means wherein the pins which normally support the wire matrix being formed on the mandrels above the core posts are withdrawn from beneath the wires permitting them to slide downwardly on the core posts for stacking, whereupon the comb is returned to the original position effective to compress the stacked wires. The winding cycle is repeated until a complete memory matrix is wound on the core forms.

For the purpose of more fully explaining the above and still further objects and features of the invention, reference is now made to the following detailed description of a preferred embodiment of the invention, together with the accompanying drawings, wherein:

FIG. 1 is an isometric view of the wiring loom according to the invention;

FIG. 2 is a fragmentary side elevation of the wire laying head and a core form of the wiring loom of FIG. 1;

FIG. 3 is a front elevation of a portion of FIG. 1 showing the row of core forms;

FIG. 4 is a plan view of the row of core forms of FIG. 3 showing two different weaving patterns; and,

FIG. 5 is an enlarged side elevation of the core form of FIG. 2 showing the elliptical path of the pins.

There is shown in FIG. 1 a wiring loom including a stationary base 10, a row 13 of core forms 14 fixed to a horizontal panel 22 and a wire laying head shown generally at 15 slideably mounted on rods 17 and 18 and connected to motor driven timing belt 20.

As seen in FIG. 1, panel 22 provided with a series of electrodes 23 arranged along opposite lateral edges is securely mounted on base 10 by means of screws. Core forms 14 totaling 14 in number, each constructed of molded plastic, are arranged in a row in spaced relationship along the top edge 25 of panel 22 parallel with the X-axis, being secured to said panel.

As shown in FIGS. 1 and 5, each core form 14 is constructed in a U-shape, is hollow for receiving magnetic cores, has a flat mounting member 28, and is provided with two cylindrical, vertical posts 30 and 31.

Each core form being aligned parallel with the Y-axis with respective post 30 adjacent edge 25 is provided with a removable plastic mandrel 33 having an oval top and curved inwardly and downwardly sloping walls for receiving wire stacked thereon as hereinafter described.

Mutually parallel rods 17 and 18, consisting of aluminum, are mounted at opposite ends in spaced transverse vertical walls 35 and 36 provided in base 10, and extend horizontally in the X-axis direction in parallel alignment with base 10. Mounted on rods 17 and 18 in sliding engagement therewith is a wire laying head 15 including a movable carriage 40 supporting an electrically operated rotary solenoid 42 connected by leads to a remotely located control system comprising a programmer adapted to receive input such as punched cards or magnetic tape and to emit signals controlling the operation of drive 79 and solenoid 42 of known construction shown generally at 44. Post 46 (see FIG. 2) connected to the internal armature of solenoid 42 reaches through an opening provided in the solenoid housing for engagement with upwardly extending rocker arm 48 and horizontally arranged drive bar 50.

Included in wire laying head 15 is a hollow arm 52 provided with a threading tip 54 at the lower end positioned adjacent row 13 and a guide tube 56 at the upper end. Being pivotally mounted in bracket 58 secured to carriage 40, arm 52 is connected to solenoid 42 by drive bar 50 for reciprocal movement parallel to the Y-axis from the "in" position shown in heavy lines in FIG. 2 to the "out" position shown in dotted lines.

Guide prongs 60 and 61 are provided adjacent threading tip 54 for extending through the spacing provided between adjacent core forms 14 for centering arm 52 relative to respective posts 30 to be wound with wire.

Rocker arm 48, pivotally mounted on rod 63 extending horizontally between upright posts 65 and 66 on carriage 40, is provided with oppositely extending lateral members 68 and 69 overlying microswitches 72 and 73 secured in spaced relationship on said carriage and an integral vertical shaft secured at one end to post 46. Microswitches 72 and 73 are electrically connected to control system 44 for matching the actual position of arm 52 (i.e., "in") relative to a given post 30 with the programmed position (i.e., "in").

Timing belt 20 is supported between drive wheel 77, mounted on drive 79, and idler wheel 80 mounted on bracket 82 in parallel alignment with rod 17 and is attached at terminal portions to opposite sides of carriage 40 for horizontally driving wire laying head 15 reciprocally along rods 17 and 18. Drive 79, consisting of a stepping motor constructed with a total of 200 steps and designed to hesitate during rotation every 15 steps for positioning wire laying head 15 relative to the row of core forms 13, is connected to the control system 44 for operating timing belt 20 in either clockwise or counterclockwise directions in synchronization with the operation of solenoid 42. Limit switches 83 and 83a are mounted on walls 35 and 36 for contacting carriage 40 and stopping drive 79 at the traverse limits of said carriage.

Continuous wire 92 fed from a remotely located spool to guide tube 56 extends through the central hollow passage provided in arm 52 and projects outwardly through threading tip 54 for winding around respective posts 30.

Further included in the wiring loom is a comb 84 comprising a bar 86 extending horizontally adjacent and parallel with the row of core forms 13, having pins 88 projecting perpendicularly forward between mandrels 33 mounted on posts 30. At opposite ends of bar 86, beams 87 and 87a project rearwardly in the Y-direction having respective distal ends pivotally secured to posts offset from the axis of discs 89 and 89a mounted on shaft 97. Intermediate bar 86 and discs 89, beams 87 and 87a are movably supported by links 94 in turn mounted in swivels 96 provided on base 10. Rotation of discs 89 by a conventional electric motor 90 connected to shaft 97 by means of a chain drive displaces bar 86 and pins 88 through an elliptical path adjacent mandrels 33 to control the stacking of wires thereon (see FIG. 5)

In operation, wire 92 is threaded on arm 52, normally arranged in the "in" position, when wire laying head 15 is positioned by timing belt 20 on the left hand extremity of rods 17 and 18 adjacent wall 35. Input in the form of magnetic tape defining a given wiring pattern is supplied to control system 44 for regulating the operation of solenoid 42 and electric drive 79. Drive 79 rotates drive wheel 77 in a counterclockwise direction moving timing belt 20 also in a counterclockwise direction to displace wiring head 15 horizontally toward wall 36 along rods 17 and 18. The periodic hesitation of drive 79 causes wire laying head 15 to pause opposite each spacing provided in row 13. During traverse of wire laying head 15, solenoid 42 alternatively moves arm 52 toward or away from the row of core posts to the "in" or "out" position responsive to control system 44 signals, passing tip 54 through the spaces provided between adjacent core posts 30 effective to wind the wire around mandrels 33 in a pattern regulated by control system 44 as seen in FIG. 4.

As post 46 is moved arcuately by the armature of solenoid 42 to displace arm 52 from the "out" position to the "in" position, rocker arm 48 is pivoted about the axis of rod 63 such that lateral member 69 closes microswitch 73 and opposite lateral member 68 opens microswitch 72 to provide feedback to control system 44. Reverse movement of arm 46 pivots rocker arm 48 in the reverse direction to close microswitch 72 and open microswitch 73. In the event solenoid 42 fails to actuate rocker arm 48 responsive to a given weaving pattern programmed in the control system and the appropriate

microswitch is not consequently closed by said rocker arm, control system 44 stops drive 79 permitting immediate error detection.

Once wire laying head 15 has traversed the entire row 13 of core posts 14, a segment of wire 92 is soldered to the proper electrode mounted on the right hand side of panel 22; thereafter, the wire is cut to provide a free end to be attached to a second electrode. With wire 92 thus secured to a second electrode, timing belt 20 is driven in a clockwise direction by drive 79 responsive to control system 44 to cause wire laying head 15 to traverse toward wall 35 and wind a second wire pattern around row 13. Winding is repeated by cycling wire laying head 15 reciprocally until the wiring matrix is completed.

As seen in FIG. 5, successive wires are supported by the curved walls of mandrels 33 above pins 88 normally occupying position *b*, the mandrels being of greater diameter than post 30. The smooth surfaces of the mandrels act to guide the wires as they are wound and prevent tangling. Periodically, comb 84 is reciprocally cycled causing the tip of pins 88 to move through an elliptical path permitting the accumulated wires 95 to drop down to surround post 30, being compressively stacked thereon as the pins move from position *c* to *a*.

Other embodiments will occur to those skilled in the art and are within the following claims.

What is claimed is:

1. An automatic wiring loom for weaving wire onto a workpiece having a row of magnetic core memory posts comprising workpiece support means aligning and supporting in a predetermined position said workpiece with track means positioned parallel to said support means carrying said row of core posts and spaced therefrom wire laying carriage means movably mounted on said track including wire weaving arm means movable in a direction normal to said support means carrying said row of core posts and to said track means, said arm means being movable between a first position in which said arm means is spaced from one side of said row of core posts adjacent said track to a second position in which said arm is spaced from the opposite side of said row of core posts, and control means for controlling said carriage and arm means to weave said wire about portions of said posts in a predetermined pattern.
2. An automatic wiring loom as claimed in claim 1 wherein a comb is provided for alternatively stacking wire segments on the core posts and compacting said wires on the base of said posts.
3. An automatic wiring loom as claimed in claim 1 wherein said pattern may be readily altered by changing input consisting of memory elements to said control means.
4. An automatic wiring loom as claimed in claim 1 wherein said arm means is connected to a rotary solenoid mounted on said carriage means for movement in a direction normal to said row of core posts and to said track means.
5. An automatic wiring loom for weaving wire onto a workpiece having a row of magnetic core memory posts comprising workpiece support means aligning and supporting in a predetermined position said workpiece with track means positioned parallel to said support means carrying said row of core posts and spaced therefrom wire laying carriage means movably mounted on said track means including wire weaving arm means movable in a direction normal to said support means carrying said row of core posts and to said track means, said arm means being movable between a first position in which said arm means is spaced from one side of said row of core posts adjacent said track to a second position in which said arm is spaced from the opposite side of said row of core posts, traverse means connected to said carriage means for effecting reciprocal movement of said carriage means along said track means control means for controlling said carriage and arm means to reciprocally weave said wire about portions of said

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posts in a predetermined pattern in both the right hand and left hand direction
detecting means connected to said arm means and said control means for monitoring weaving of said pattern to detect weaving errors and arrest said carriage and arm means facilitating removal of said errors.

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6. An automatic wiring loom as claimed in claim 5 wherein said traverse means includes a timing belt connected to said carriage means, said belt being driven by an electric stepping motor.

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