United States Patent

Walter

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[54] **TERMINAL STRAIGHTENING METHOD AND MACHINE**

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[73] Assignee: **Malco Manufacturing Company, Inc.,** Chicago, Ill.

[22] Filed: **Feb. 16, 1971**

[21] Appl. No.: **115,747**

Related U.S. Application Data

[63] Continuation of Ser. No. 824,349, April 21, 1969, abandoned.

[52] **U.S. Cl.** **140/147,** 140/149

[51] **Int. Cl.** **B21f 7/00**

[58] **Field of Search**...140/147, 149, 119; 72/DIG. 10

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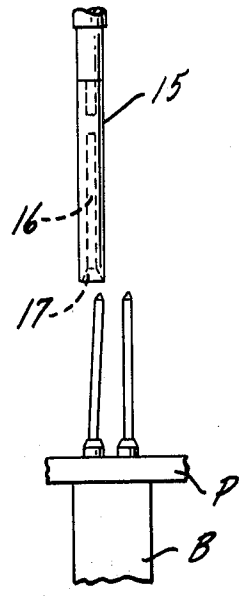
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Primary Examiner—Charles W. Lanham
Assistant Examiner—Michael J. Keenan
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[57] **ABSTRACT**

A method of straightening bent wire-wrap posts of electrical terminals in a group of terminals and a machine for practicing the method. The method contemplates bending posts misaligned with corresponding terminal axes back into alignment with respective axes and then twisting them on said axes through a sequence of twists which culminates in return of the posts to generally their original radial orientation on the respective axes and fixing of the posts in alignment with such axes. The machine performs this method by telescopically engaging all the terminals in a group of terminals with a corresponding group of spindle wrenches. The initial engagement places all wire wrap posts in alignment with corresponding axes. Rotation of the spindle wrenches through a rack and pinion arrangement according to a prescribed sequence is effective to perform the aforedescribed twisting operation on the posts in the group.

14 Claims, 17 Drawing Figures



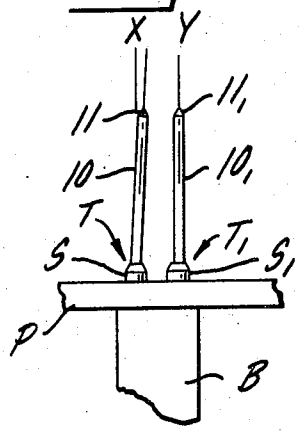


fig.1.

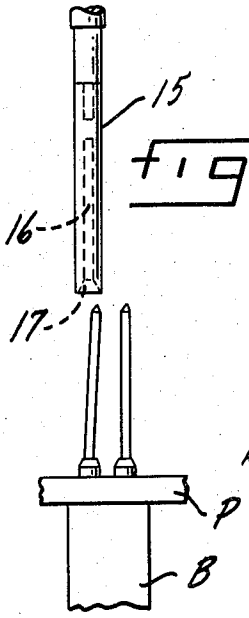


fig.2.

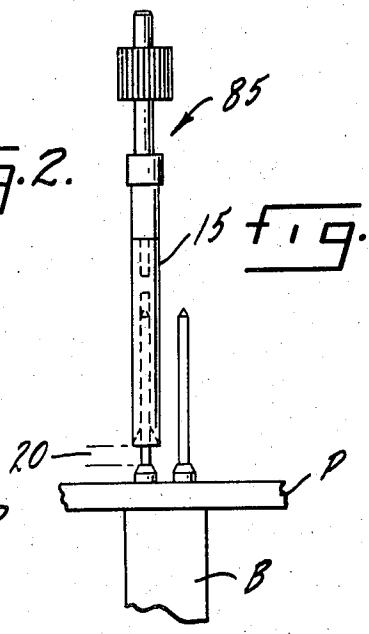


fig.3.

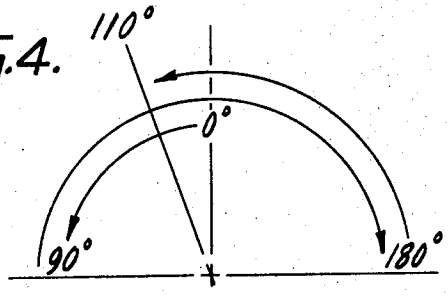


fig.4.

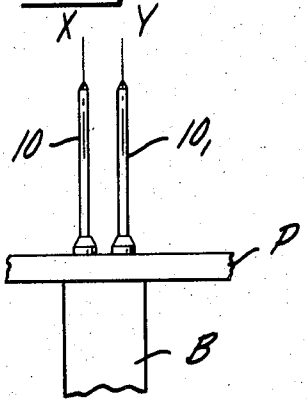


fig.5.

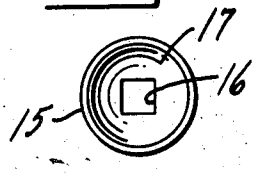


fig.6.

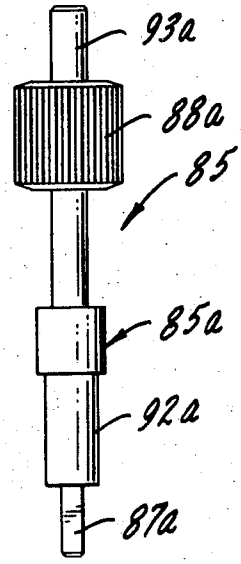


fig.15.

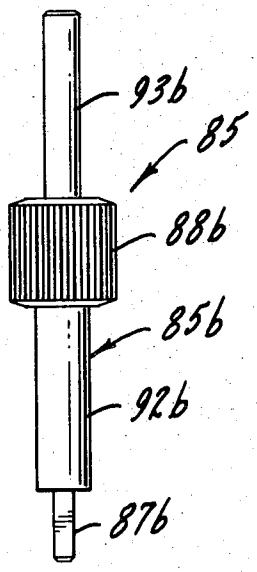


fig.16.

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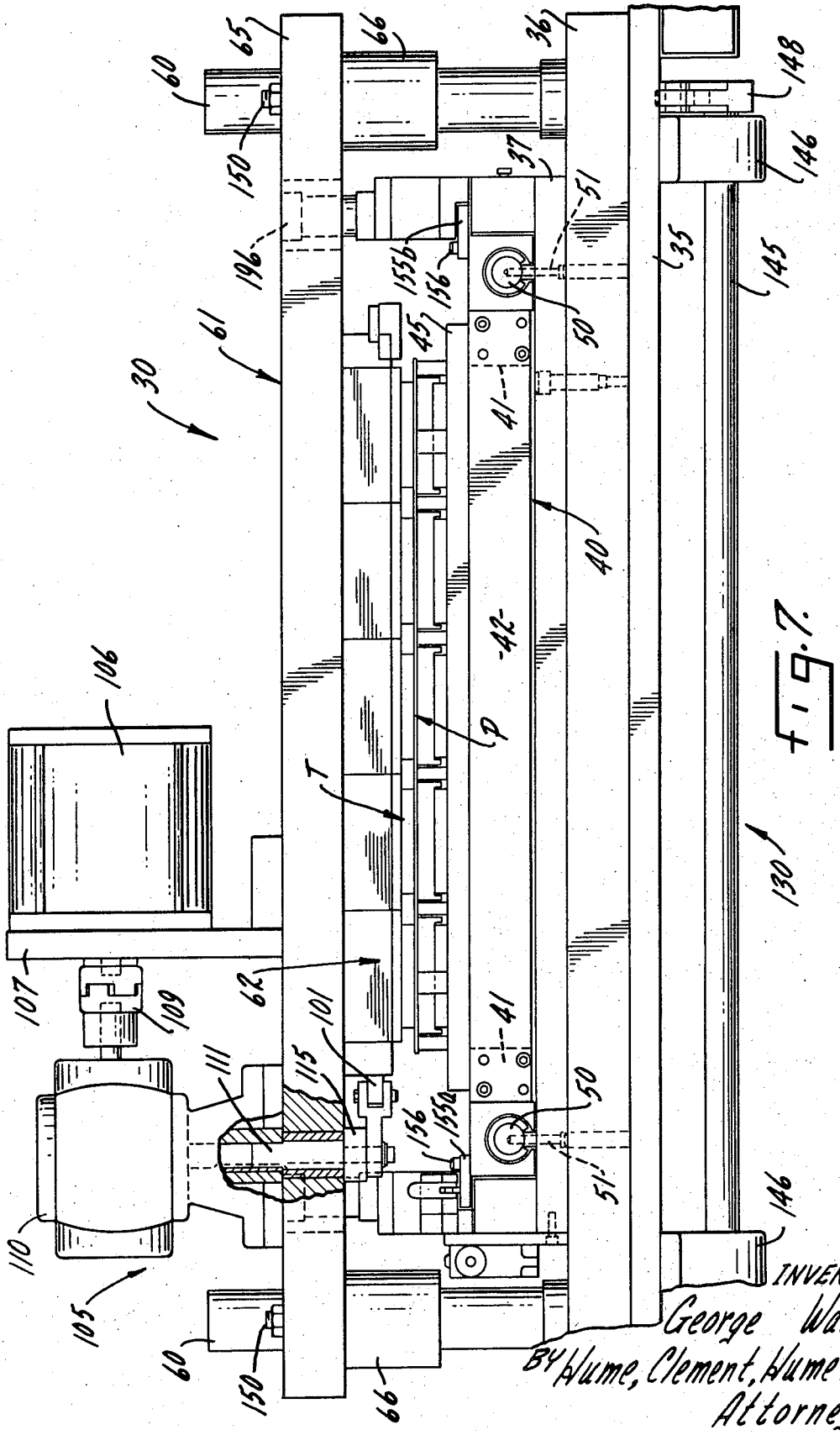


FIG. 7.

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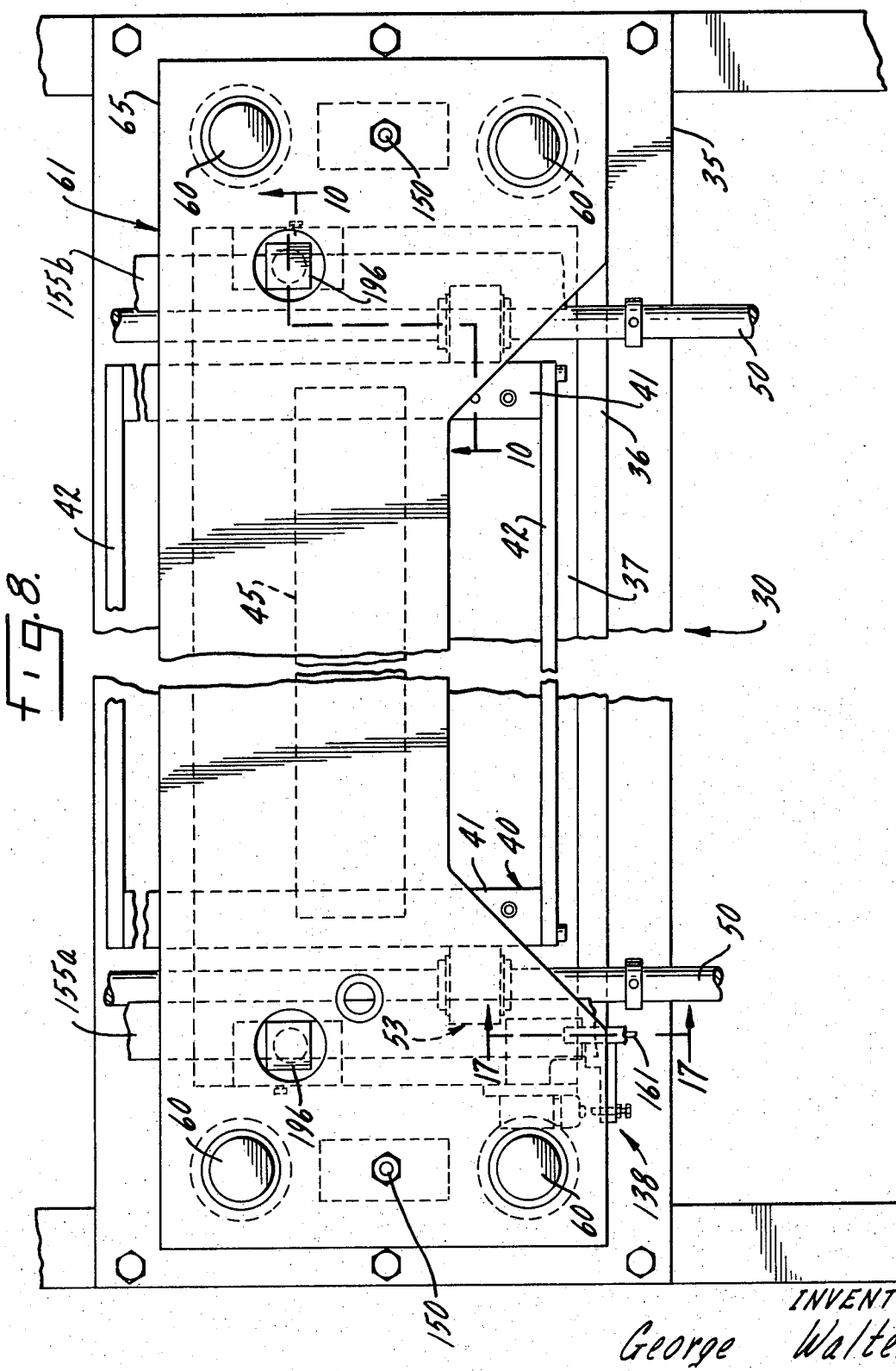


FIG. 8.

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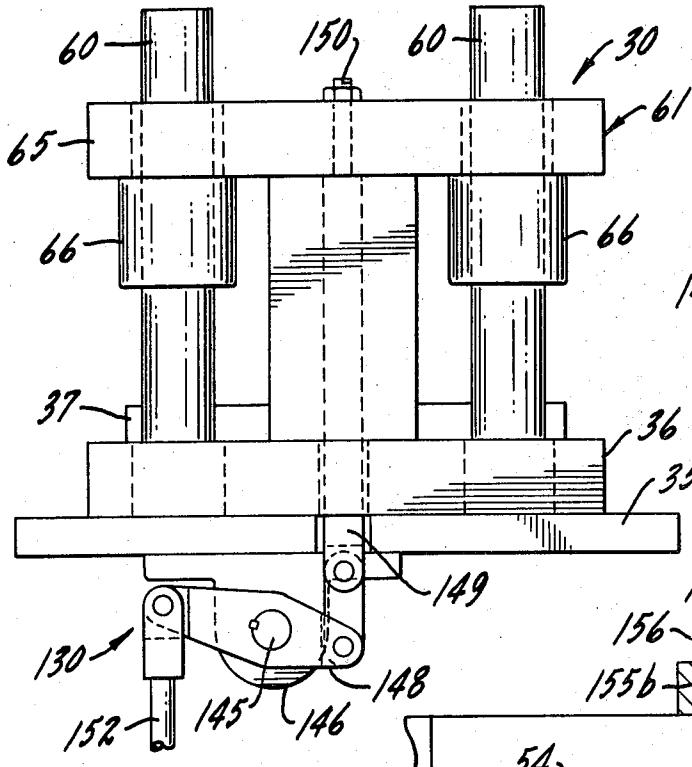


Fig 9.

Fig 10.

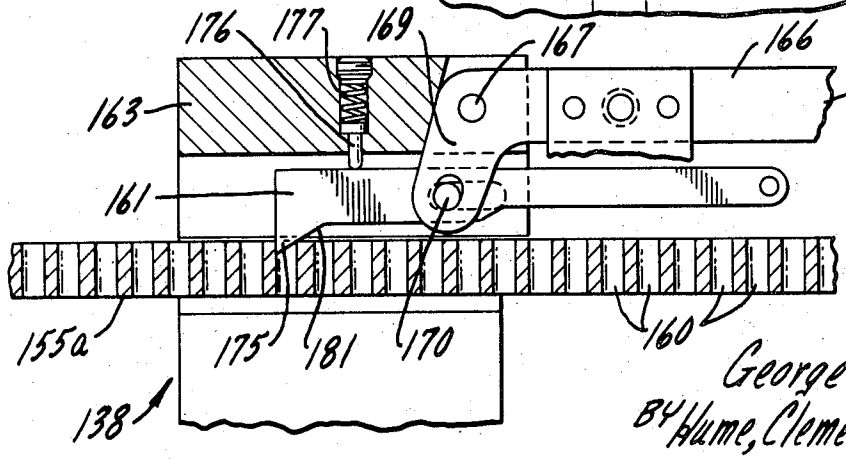
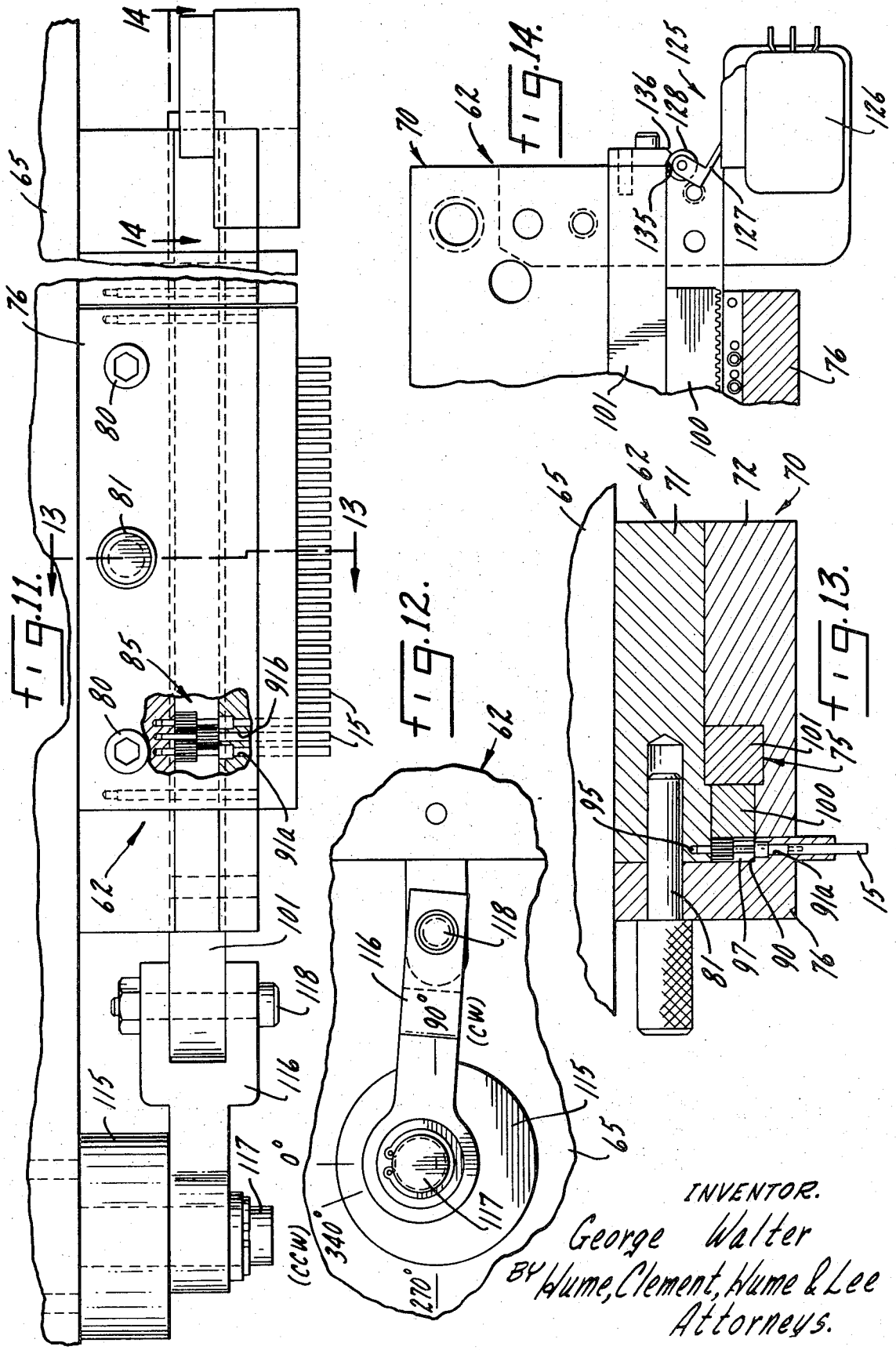


Fig 17.

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TERMINAL STRAIGHTENING METHOD AND MACHINE

BACKGROUND OF THE INVENTION

This application is a continuation of the co-pending application of George Walter, Ser. No. 824,349, filed Apr. 21, 1969, entitled TERMINAL STRAIGHTENING METHOD AND MACHINE, now abandoned.

This invention is in the field of electrical terminal connectors. It deals particularly with terminal connectors of the type which include wire wrap posts on the terminals and wherein the terminals themselves are seated in a prescribed pattern in a matrix plate or block or the like.

It is now common practice to assemble terminal connector complexes comprising thousands of terminal connectors seated in a matrix. These connectors conventionally comprise a terminal pin which is either molded into a block or mounted in a bushing which extends through an aperture in a mounting plate. In either case, the terminal pin conventionally has formed, on at least one of its two ends, a wire wrap post. It is the function of this wire wrap post to receive, by well-known wire wrapping techniques, the bared end of a conductor wire.

In practice, a large plate, for example, containing a complex of several thousand terminal connectors in closely spaced relationship, is positioned in a predetermined manner on an automatic wire wrapping machine. The plate is precisely located on the bed of the wire wrapping machine so that a wire wrap head can successively descend, wrap the bared end of a conductor wire around a predetermined wire wrap post, ascend, and proceed to the next selected post to make a wire wrap connection. Since the terminal pins are all precisely located, within certain tolerances, on the terminal plate, proper positioning of the plate relative to the wire wrap head normally permits the head to accurately descend and ascend in its wire wrapping pattern in precisely the correct relationship with each wire wrap post selected.

If a terminal pin were out of position on the plate, however, the wire wrap head would not be properly oriented relative to the pin and, in descending, might not grip the pin properly and thus not wire wrap it properly. For that matter, the terminal and even the machine itself can be damaged if this occurs. Fortunately, the positioning of the terminal pins on the board is very accurately controlled and mis-positioning is, for all practical purposes, non-existant.

It is not uncommon, however, for a properly positioned terminal pin to have its wire wrap post bent to a lesser or greater degree, either during the terminal insertion process, or in handling of the terminal plate once it has been assembled and before it is shipped to a customer for connection into a computer module, for example. In order to assure that the wire wrap post of each terminal pin is precisely positioned on the axis of the pin, it is presently necessary to check the positioning and attitude of each of these wire wrap posts individually under magnification. Where a post is found to be outside predetermined tolerances, it is individually bent back to alignment for acceptance of the wire wrap head in the subsequent wire wrapping operation. This is a laborious, time-consuming, and consequently expensive operation, as will be readily understood.

SUMMARY OF THE INVENTION

A primary object of the present invention is to provide a vastly improved method of straightening the wire wrap post of an electrical terminal seated in base means, whereby the post is returned from misalignment with the longitudinal axis of the terminal to alignment therewith and fixed on the axis. It is another object to provide a method of straightening the randomly distributed, misaligned wire wrap posts in a group of wire wrap posts without the necessity of searching out the misaligned posts. It is still another object to provide a method of straightening randomly distributed misaligned posts in a group of posts by uniform treatment of all of the posts. It is yet another object to provide a method wherein the posts tensile strength remains substantially unimpaired.

It is a further object of the invention to provide a machine for straightening wire wrap posts which are out of alignment with the longitudinal axes of corresponding terminal connectors. Still a further object is to provide a machine which engages a large group of wire wrap posts and straightens the randomly distributed misaligned posts in the group, whereby the necessity of searching out individual misaligned posts for straightening is obviated.

The foregoing and other objects are realized in accord with the invention by providing a method wherein a misaligned wire wrap post of an electrical terminal connector is first bent into alignment with the longitudinal axis of the terminal. The post is then twisted in one direction on this axis through a first predetermined number of degrees of arc from its original radial orientation on the axis. The post is then twisted in the opposite direction on the axis past its original radial orientation through a second predetermined number of degrees of arc. Finally, the post is once again twisted in said one direction on the axis through a third predetermined number of degrees of arc sufficient to return it slightly past its original radial orientation on said axis. The post is then released and it remains in precise alignment with the axis.

An important feature of the method is that all wire wrap posts in a group, both straight and bent, are treated simultaneously in the aforedescribed manner. Thus, the randomly distributed, misaligned posts in a group are automatically straightened without the necessity of searching out specific misaligned posts. Another feature of the method is that all the posts retain, virtually intact, their physical characteristics, particularly tensile strength. In testing, there was found to be less than a 1½ percent decrease in tensile strength of a twisted post.

A separate aspect of the invention is the machine which can perform the steps of the method. The machine head engages an entire group of terminal posts. It performs the twisting operations on the group. The head then sequences to the "next" group of terminals and its head engages them. The twisting and straightening operation is quickly and easily performed on all terminals in a large plate, for example, in a simple and expeditious manner.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, including the method and a machine constructed to automatically perform various steps of

the method, together with the objects and advantages thereof, is illustrated more or less diagrammatically in the drawings, in which:

FIG. 1 is an end elevational view of a portion of a terminal plate showing a printed circuit board and connector block, with parts removed, and the two end terminals of the connector block, one of the terminals being bent out of alignment with the axis of the terminal;

FIG. 2 is a view similar to FIG. 1 showing the bent terminal about to be engaged by a pinion wrench in a first step of the method embodying features of the invention;

FIG. 3 is a further developed illustration of the first step of the method;

FIG. 4 is a generally graphic illustration of the wire wrap post twisting pattern employed with the specific twists illustrated and described;

FIG. 5 is a view similar to FIGS. 1–3 illustrating the terminal post after it has been straightened according to the method of the invention;

FIG. 6 is an enlarged end view of the pinion wrench illustrated in FIG. 2;

FIG. 7 is a front elevational view of a wire wrap post straightening machine constructed according to the invention, with parts removed;

FIG. 8 is a top plan view of the machine illustrated in FIG. 7, also with parts removed;

FIG. 9 is an end elevational view of the machine, also with parts removed;

FIG. 10 is a sectional view taken along line 10—10 of FIG. 8;

FIG. 11 is an enlarged front elevational view of the machine's head mechanism which is adapted to engage and straighten terminal wire wrap posts according to the invention, with parts removed and others shown in section;

FIG. 12 is an enlarged, bottom plan view of a portion of the head mechanism illustrated in FIG. 11;

FIG. 13 is a sectional view taken along line 13—13 of FIG. 11;

FIG. 14 is an enlarged sectional view taken along line 14—14 of FIG. 11;

FIG. 15 is a further enlarged view of one of the pinion spindles of the head mechanism illustrated in FIG. 11;

FIG. 16 is a further enlarged view of another pinion spindle from the head mechanism of FIG. 11; and

FIG. 17 is a sectional view taken along line 17—17 of FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and particularly of FIGS. 1-5, the method embodying features of the invention is diagrammatically illustrated. Employing the method, the bent wire wrap post **10** of the terminal T, as seen in FIG. 1, is returned to precise alignment with the longitudinal axis X of the terminal T, as seen in FIG. 5. More precisely then, FIGS. 2–4 illustrate the actual steps of the method embodying features of the invention, FIG. 1 illustrates the terminal T with its wire wrap post **10** bent out of alignment, and FIG. 5 illustrates that same wire wrap post **10** after straightening according to the invention.

Turning specifically to FIG. 1, the two end terminals T and T_1 in a two row connector insulator body B are illustrated. The wire wrap post **10** of the terminal T is bent substantially out of alignment with the longitudinal axis X of the terminal, while the wire wrap post 10_1 of the terminal T, is in substantially precise alignment with its terminal axis Y.

The insulator body B is seated, in a well-known manner on a terminal plate P. Bushing sleeves S and S_1 of the body B extend through corresponding apertures (not shown) in the plate P and the terminals T and T_1, in turn, extend from within the body B through the bushing sleeves. Female portions (not shown) are conventionally formed on corresponding ends of the terminals T and T_1 within the body B, while the opposite ends of the terminals are formed into the wire wrap posts **10** and 10_1.

In the present illustration, the terminals T and T_1 and, accordingly, the wire wrap posts **10** and 10_1, are fabricated from half-hard brass by conventional die punching methods. The terminals are formed so that the wire wrap posts **10** and 10_1 are approximately 0.025 inch square in cross-section. Pyramid-shaped tips **11** and 11_1 are formed, in a well-known manner on the free ends of corresponding posts **10** and 10_1, to facilitate ultimate machine wire wrapping.

Referring now specifically to FIGS. 2 and 3, the first step of the method for straightening the wire post **10** of the terminal T, according to the present invention, is bending the post **10** into alignment with the axis X of the terminal. In practice, this is accomplished by a spindle wrench **15** which is mechanically aligned with the axis X.

The spindle wrench **15** has an elongated bore **16** which is square in cross-sectional configuration. Referring to FIG. 6, the cross-sectional dimensions of the bore **16** are slightly greater than the cross-sectional dimensions of the post **10**. A downwardly widening frusto-conical mouth **17** is formed in the lower end of the spindle wrench **15**, providing access to the relatively smaller bore **16**.

The spindle wrench is brought downwardly onto the post **10** in alignment with the axis X. The cross-sectional dimensions of the mouth **17** are such that as the spindle wrench **15** moves downwardly, a wire wrap post **10** which is bent even considerably out of line with the axis X will enter the mouth **17**. The pyramid shaped tip **11** on the post **10** is an aid to this, of course.

As the spindle wrench **15** continues to descend, the mouth **17** directs the free-end of the wire wrap post **10** toward the bore **16** of the wrench, thus bending the post toward the axis X. FIG. 3 illustrates the arrangement of the wire wrap post **10** within the bore **16** of the spindle wrench **15** when the spindle wrench has reached its lowermost position. In this position, the greater portion of the post **10** is telescoped in the bore **16**, while a short section **20** of the post immediately adjacent the corresponding bushing sleeve S remains outside of the bore **16**. The entire post **10** is aligned with the axis X.

With the post **10** telescoped within the bore **16** of the spindle wrench **15** in the aforedescribed manner, the next step is to twist the post **10** on the axis X, according to the invention. Referring to FIG. 4, the spindle wrench **15** is first rotated about its axis in one direction

(counter-clockwise) for a predetermined number of degrees. Because the post **10** is square in cross-sectional configuration and telescoped within the square bore **16** of the spindle wrench **15**, it is twisted on the axis X through a corresponding number of degrees. For reasons hereinafter discussed in greater detail, with the terminal T illustrated and the relative length of the post section **20**, this predetermined first number of degrees of rotation is through an arc of approximately 90°. The full twisting of the post **10** takes place in the section **20** at the base of the terminal post **10**.

After the spindle wrench **15** has twisted the post **10** through a first angular distance of 90° in said one direction, rotation of the wrench **15** is stopped in that direction and it is rotated in the opposite direction (clockwise) through approximately 180°. Accordingly, the wire wrap post **10** is twisted in the opposite direction on the axis X through approximately **180°**, the twisting all taking place in the section **20** at the base of the post **10**.

Having rotated in the opposite direction through a predetermined number of degrees, 180° in the present illustration, rotation of the spindle wrench **15** in that direction is halted. The wrench **15** is then rotated in the original (counter-clockwise) direction on the axis X through approximately 110° of arc. When the post **10** has been twisted through this approximately 110° arc on the axis X, the spindle wrench **15** is raised to release the post. As seen in FIG. **5**, the post **10** remains in substantially perfect alignment with the axis X of the terminal once it has been treated with the aforedescribed twisting operations. It does not return to its original, misaligned position because metal in the section **20** at the base of terminal post **10** has been deformed, i.e., twisted, beyond its limit of elastic deformation.

The sequence and degree of twisting described is particularly suited to terminals of the type illustrated; i.e., half-hard brass terminals having 0.025 inch square wire wrap posts wherein the terminals are fabricated from sheet stock by die punching or the like. These factors, as well as others, determine exactly how the post **10** is twisted.

If the type of material, that is the composition of the metal alloy in the terminal T is varied, it should be understood that the sequence and degree of twisting would be modified. Similarly, depending upon how the terminal pin is fabricated, i.e., by punching, drawing, etc., this treatment would further vary. The effect of plating the metal terminals, heat-treating them, or treating the surface in some other way has similar effects on the manner in which the terminal is twisted according to the invention.

The twisting operation is also modified within the perview of the invention when wire wrap posts of different shape are employed. Furthermore, by varying the length of the section **20** which is actually stressed during the twisting operation of the post **10**, the type and extent of twisting can be modified.

In essence, there are three major variables in the twisting operation. These major variables can, in turn, be broken down. In summary, they are as follows:

1. The material characteristics of the wire wrap post, including
   a. type of material (various metal alloys)
   b. inherent stress lines in material (determined by metal grain structure as, in turn, effected by the method of forming the metal, i.e., punching, drawing, etc.)
   c. treatment of the material (heat-treated, pickled, plated, etc.)
2. The physical shape and dimensions of the wire wrap post.
3. The length of the section of the wire wrap post which is being stressed during the twisting operation.

The variables each affect the twisting scheme for a prescribed terminal. Regardless, however, the wire wrap post in question is bent into proper alignment, twisted from its original radial orientation on the axis and finally twisted again to substantially its original orientation. In practice, the final radial orientation may be slightly different than the original, but this is of no consequence or purpose.

Turning now to FIGS. **7–17**, a machine developed to perform the method of the invention is illustrated. Referring specifically to FIGS. **7**, **8**, and **9**, the machine is illustrated generally at **30**. The machine **30** is effective to engage a large group or row of terminals, as seen in FIG. **7**, simultaneously twist each terminal in the row, according to the invention, and sequentially move to succeeding rows of terminals to perform the same operation.

Still referring to FIGS. **7–9**, the machine includes a generally rectangular plate **35**, upon which is mounted, in a conventional manner, a slightly smaller rectangular base plate **36**. In turn, a somewhat smaller, rectangular mounting plate **37** is secured in a conventional manner to the upper surface of the base plate **36**.

Supported for movement from front to back on the mounting plate **37** is a platen assembly **40**. The platen assembly **40** includes a longitudinally extending side bar **41** joined by transversely extending front and back stringers **42**. Extending transversely between the side bars **41**, intermediate the front and back stringers **42**, is an elongated, rectangular work platen **45**. It is on the work platen **45** that the matrix plates P, for example, containing groups or rows of terminals T, are mounted for straightening by the machine **10**, all in a manner hereinafter discussed in detail.

The platen assembly **40** is mounted for sliding movement, front to back, on the mounting plate **37**, on horizontal mounting shafts **50** secured to the mounting plate. The shafts **50** are transversely spaced, as illustrated best in FIGS. **7** and **8**, and are rigidly supported from the mounting plate **47** by machine bolts **51** extending up through the plate and spacer saddles **52** between the plate and the corresponding shaft, as best seen in FIG. **10**. At least two mounting collars **53** (only one shown) are secured to each side bar of the platen assembly **40** in front-to-back spaced relationship, and these collars encircle and mount the platen assembly **40** on the mounting shafts **50**. As seen in FIG. **10**, the collars are box-like in external configuration and have a split, bearing sleeve liner **54** extending transversely therethrough for engaging and sliding on the corresponding shaft **50** in bearing relationship. The bearing rings **54** are split, as illustrated, to afford access to the mounting bolts **51** and spacer saddles **52** supporting the shafts **50**.

Suitably mounted in the four corners of the base plate **36**, and extending upwardly therefrom, are four identical guide posts **60**. Vertically slideable on the guide posts **60** is a head assembly **61**. The head assembly **61** includes, according to the present invention, head mechanism **62** which engages the wire wrap post **10** of terminals T on the matrix plate P, and straightens bent wire wrap posts according to the method of the invention.

The head assembly **61** comprises a generally rectangular head plate **65** which mounts four bearing sleeves **66** through which the posts **60** extend. In operation, the plate **65** moves vertically on the post **60** to bring the head mechanism **62** into and out of engagement with the terminals T as each row or group of terminals is processed, all in a manner hereinafter discussed.

The head mechanism **65** is illustrated in substantial detail in FIGS. **11–16**. Referring to these fingers, the head mechanism **62** is seen to include an elongated housing **70**, rectangular in cross-section (see FIG. **13**), and secured to the bottom of the head plate **65**. The housing **70** includes a roof plate **71** actually secured to the head plate by conventional means such as machine bolts or the like (not shown). A floor plate **72** is secured to the roof plate **71**, also by conventional means such as machine bolts (not shown), and the opposed surfaces of the roof plate **71** and floor plate **72** are so shaped as to define a stepped slot **75** extending the length of the housing **70** adjacent the front of the housing. A face plate **76** forms a front closure for the stepped slot **75** and defines the front face of the housing **70**. The face plate **76** is secured to the roof plate **71** by two conventional side bolts **80** and, to facilitate easy handling of the face plate **76** when the side bolts **80** have been removed preparatory to removing the face plate, a center bolt **81** with a knurled head for hand turning.

The face plate **76** serves as a carrier for a series of closely spaced spindle wrenches **15**. Each of these spindle wrenches **15** is identical in construction, and has hereinbefore been described in detail in relation to the method embodying features of the invention.

Each pinion wrench **15** is mounted on a pinion gear spindle **85**. However, alternate spindle wrenches **15** are mounted on alternating forms **85***a* and **85***b* of the pinion spindles. These alternating forms of pinion spindles **85***a* and **85***b* are shown in substantial detail in FIGS. **15** and **16**. Each includes a rectangular cross-section tip **87***a* and **87***b* upon which the spindle wrench **15** is forced in press-fit relationship, a suitable end aperture being provided in the end of each wrench **15** to receive the corresponding tip. In the pinion spindle **85***a*, however, the pinion gear **88***a* is displaced upwardly relative to the pinion gear **88***b* on the pinion spindle **85***b*. As a result, the pinion spindles **85***a* and **85***b* with their attached pinion wrench **15** nest in closely spaced relationship on an inner ledge **90** extending the length of the face plate **76**.

Suitably formed bores **91***a* **and** 91*b* extend downwardly through the face plate **76** from the ledge **90** and are adapted to receive the distinctly shaped lower bearing stubs **92***a* and **92***b* of the pinion spindles **85***a* and **85***b*, respectively, as well as the pinion wrenches **15** themselves. The pinion spindles **85** with their attached pinion wrenches **15** are thus mounted for rotation in the bores **91***a* and **91***b* on the axes of corresponding bores.

With the face plate **76** seated in place, as illustrated in FIG. **13**, upper stub bearings **93***a* and **93***b* on the pinion spindles **85***a* and **85***b*, respectively, seat in corresponding stub bores **95** formed in the lower face of the roof plate **71** in spaced relationship along its front edge. The snugly nested pinion gears **88***a* and **88***b* are spaced along the length of the gear cavity **97** formed within the housing **70**.

The pinion gears **88***a* and **88***b* are rotated by an elongated rack **100** slideably mounted in the outer portion of the stepped slot **75** through the housing **70**. The rack **100** is in mesh with both pinion gears **88***a* and **88***b* and is rigidly secured on an elongated carrier bar **101** extending through the larger inner portion of the slot **75**. Movement of the carrier bar **101** in the slot **75** is effective to rotate the pinion gears **88***a* and **88***b* in either a clockwise or counter-clockwise direction, depending upon the direction of movement of the carrier bar **101**, and thus rotate the spindle wrenches **15** accordingly.

The carrier bar **101**, and accordingly, the rack **100** is moved longitudinally through the slot **75** to rotate the spindle wrenches **15** by the power train assembly **105** of the head mechanism **62**. The power train assembly **105** includes a conventional electric motor **106** secured to a mounting bracket **107** on top of the head plate **65**. The motor **106** is a horsepower motor of any well-known commercial type.

The motor **106** is connected through a drive shaft and coupling **109** to a speed reducer sub-assembly **110**, also of conventional construction, which contains suitable gearing for reducing output shaft speed. The speed reducer sub-assembly **110** has a vertically depending output shaft **111** extending through a suitably formed aperture in the head plate **65**. The speed reducer **110** is mounted in a suitable manner on the top of the head plate **65**.

Referring particularly to FIGS. **7**, **11** and **12**, the lower end of the speed reducer output shaft **111** extends below the head plate **65** and mounts an annular disc **115** in rigidly connected relationship. A drive link **116** is pivotally connected, in eccentric relationship at **117**, to the disc **115** and, in turn, is pivotally connected to a corresponding end of the carrier bar **101** at **118**.

It should now be seen that rotation of the disc **115** causes the bar **101** to reciprocate in the stepped slot **75**, and the bar carries the rack **100**. It will further be recognized that the extent of longitudinal movement of the rack **100** is determined solely by the degree of eccentricity of the pivotal connection **117**. It is, of course, the extent to which the rack **100** moves longitudinally in the slot **75** that determines the degree of rotation, in either direction, of the spindle pins **85** and, accordingly, the spindle wrenches **15**.

Referring to the method of the invention hereinbefore described, the desired amount of twisting of various wire wrap posts fabricated of varying materials, of varying size and configuration, having been treated in various ways, varys considerably. For purposes of illustration, however, in accord with optimum practice where a terminal T of the type described is used, a 90° counter-clockwise twist, followed by a 180° clockwise twist, followed in turn by approximately a **110°** counter-clockwise twist, produces precise alignment of

bent terminal wire wrap posts **10** of the terminals T with the axes X of these terminals while having minimal effect on the desirable physical characteristics and properties of the metal terminal.

The rack travel and gear ratio relationship of the rack **100** and the pinion gears **88***a* and **88***b* are coordinated with the degree of eccentricity of the pivot **117** from the center of rotation of the disc **115** to provide that in one complete rotation of the disc **115** each spindle wrench **15** will rotate through 360°, 180° in a counter-clockwise direction followed by, or preceeded by, 180° of rotation in a clockwise direction. With this in mind, to obtain the required sequence and degree of rotation of the spindle wrenches **15** in the present illustration, the motor is controlled in a manner hereinafter discussed so that when the spindle wrenches **15** descend and engage a row of terminals T, the radial of the disc **115** passing through the centerpoint of the pivotal connection **117** for the drive link **116** is at 0°, as seen in FIG. **12**.

When the motor **106** is energized, the disc **115** is rotated in a counter-clockwise direction. As the aforementioned radial passes through the 270° position on the compass (rotating in a counter-clockwise direction) each spindle wrench **15** has rotated in a counter-clockwise direction for 90°, thus twisting corresponding wire wrap posts **10** correspondingly. Continued counter-clockwise rotation of the disc **115** until the aforementioned radial reaches the 90° position on the compass, as seen in FIG. **12**, causes the spindle wrenches **15** to reverse their direction of rotation (at the 270° position) and rotate through 180° in the opposite, or clockwise direction. The wire wrap posts **10** are twisted accordingly.

Continued rotation of the disc **115**, wherein the radial of the disc passing through the center of the pivotal connection **117** moves in a counter-clockwise direction from the 90° position to, and past, the 0° position to the 340° position, again effects reversal of the rotation of the spindle wrenches **15**. The spindle wrenches **15** during this segment of rotation of the disc **115** are rotated once again in a counter-clockwise direction, through approximately 110°. The wire wrap post **10** telescoped within the wrenches **15** are twisted accordingly. At this point, the wrenches **15** are withdrawn from engagement with the row of terminal posts **10**, all of the terminal posts **10** in this group of terminals again being in perfect alignment with the corresponding axes of the terminals and, accordingly, ready for automatic wire wrapping.

Automatic control of the motor **106** for precisely the desired 380° of counter-clockwise rotation is afforded by suitable circuitry, a starting switch (not shown), and a cooperating limit switch assembly **125**, seen in FIG. **14**. The limit switch assembly **125** includes a conventional three-way switch **126** whose switching functions are controlled by a cam arm **127** carrying a roller **128**. The cam roller **128** is spring-loaded into engagement with one or the other of the cam surfaces **135** and **136** formed on the free end of the carrier bar **101** which mounts the rack **100**.

In operation of the head mechanism **62** by the power train assembly **105**, assume that the radial of the disc **115** extending through the pivotal center of the pivot point **117** is at 0°, as illustrated in FIG. **12**. Actuation of the motor circuit by the starting switch (not shown) draws the carrier bar **101** to the left in FIG. **14**, causing the cam surface **135** to depress the arm **127** and actuate the switch **126**, thus setting up a holding circuit through the switch **126** to maintain the motor **106** in operation.

When the disc has rotated through 360° from 0°, counter-clockwise back to 0°, the cam surface **136** engages the cam roller **128** and begins to depress the cam arm **127**. The cam arm **127** is not completely depressed until the carrier bar **101** has travelled sufficiently to move the adjoining cams **135**, **136** over dead-center of the roller **128** and bring the cam surface **136** into engagement with the roller. At this point, the holding circuit to the motor **106** is broken and an additional 20° of counter-clockwise rotation of the disc **115** has taken place. The motor **106** stops and the straightening of one row or group of terminal posts **10** is completed. When the head mechanism is withdrawn from engagement with the post **10**, a spring centering arrangement (not shown) in the speed reducer **110** once again centers the disc **115** with the aforementioned radial at 40°, preparing it for the next twisting cycle.

The machine **30** has been described in terms of its engagement with a single group, or row, of terminals to twist all the terminals in that row according to the method of the invention, and, as a result, straighten those wire wrap posts **10** in the row which might be bent out of alignment with corresponding axes of the terminals. The machine **30** has the capacity, however, to successively engage and treat an extended series of these rows of terminals. As such, it moves from row to row in a manner hereinafter discussed.

As seen in FIGS. **7** and **9**, a lift mechanism **130** is provided for raising the head assembly **61** to disengage the spindle wrenches **15** from the terminals T and T_1 when a selected row of terminals has been treated according to the invention. The lift mechanism **130** is actuated by the machine **30** operator to raise the head assembly **61**, after which the platen assembly **40** is indexed rearwardly a distance equal to the distance between the rows of terminals on the terminal plate P and the next row of terminals is caused to be engaged by the spindle wrenches **15** as the head assembly **61** is lowered.

Indexing is accomplished by the operator through an indexing mechanism **135** illustrated at FIGS **8** and **17**. The lift mechanism **130** is provided with a stop-safe mechanism **140**, as seen in FIG. **10**, which prevents the head assembly **61** from descending to cause the spindle wrenches **15** to engage terminals in the next row of terminals unless the indexing operation has precisely located the next row of terminals for receipt of the spindles.

The lift mechanism **130** includes a torque shaft **145** extending between and journalled in identical pillow blocks **146** secured to the underside of the bed plate **35** of the machine **30**. Each end of the torque shaft **145** (only one shown) outside of the corresponding pillow block **146**, mounts a crank arm **148** in transversely extending relationship. The inner end of each of these crank arms **148**, as seen in FIG. **9**, is pivotally connected to a vertically extending lift rod **149** which passes through suitably formed apertures in the plates **35** and **36** and is secured to the underside of the head plate **65** through a thread nut and bolt assembly **150**.

The opposite end of each lever arm **145** is pivotally connected to a power link **152** extending downwardly therefrom. The power link **152** is connected to a suitable motor and control arrangement (not shown) which draws it down and raises it a predetermined distance at the instance of the operator.

In the present illustration, when the operator actuates the control mechanism to draw the power link **152** downwardly, the rod **149** lifts the head assembly **61** upwardly a distance of approximately ¾ inch to 1 inch. The specific maximum rise of the head assembly **61** is not important. It is only necessary that the head assembly rides sufficiently to clear the spindle wrenches **15** of the top of the terminals for indexing to the next row of terminals, a distance obviously determined solely by the height of the wire wrap posts **10** of the terminals.

When a predetermined row of terminals has been engaged, twisted, and disengaged in the aforedescribed manner, the operator toggles the indexing mechanism **135** to index the terminal plate P rearwardly for precisely the distance between the rows of terminals. To this end, the indexing mechanism **135** includes a pair of indexing, guide plates **155***a* and **155***b* mounted on opposite sides of the platen assembly **40** on the mounting collars **53**. The guide plates **155***a* and **155***b* are best seen in FIGS. **7**, **10** and **17**. The plates **155***a* and **155***b* are secured to the corresponding mounting collars **53** in a conventional manner by machine bolts **156** and extend outwardly of the collars into guide slots of the stop-safe mechanisms **140** on opposite sides of the platen assembly **40**.

The guide plate **155**a has a longitudinally spaced series of index apertures **160** formed in it, as illustrated in FIG. **17**. Movable in and out of engagement with the apertures **160** is the actuator finger **161** of the indexing mechanism **135**.

Pivotally mounted on adjacent structure **163** fixed to the mounting plate **37** of the machine **30** is a toggle arm **166**; the pivotal connection **167** being best seen in FIG. **17**. A depending leg **169** of the arm **166** is, in turn, pivotally connected in lost-motion relationship at **170** with the actuator finger **161**, intermediate its ends. An actuator tooth **175** on the actuator finger **161** actually depends into the apertures **160** and is biased into each aperture by a spring loaded pin **176** and cooperating coil spring **177** mounted in the structure **163** immediately above the corresponding end of the actuator finger **161**.

In operation, to index the platen assembly **40** rearwardly and thus bring a next row of terminals into position under the sprindle wrenches **15**, the operator lifts the horizontal leg **180** of the actuator finger **161**, causing it to pivot around its connection **167** and draw the actuator finger **161** to the right, as seen in FIG. **17**. The inclined surface **181** on the tooth **175** rides up out of the aperture **160** in question, and the finger **161** is retracted until the tooth **175** is in position to descend into the next aperture **160** in line. The spring loaded pin **176** thrusts the tooth **175** downwardly into this aperture **160**, and the operator presses downwardly on the finger arm **180**. This causes the finger arm **180** to thrust the actuator finger **161** to the left, as seen in FIG. **17**, driving the plate **155***a* and, accordingly, the platen assembly **40** rearwardly for the prescribed distance.

The platen assembly **40** should then be in precise position relative to the head assembly **61** so that the spindle wrenches **15** can descend and precisely engage the next row of terminals on the terminal plate. The operator manipulates the mechanism **130** to bring the head assembly downwardly. Should the next row of terminals not have been brought into precise alignment for receipt of the spindle wrenches **15**, however, the stop-safe mechanism **140** is effective to prevent this power movement of the head assembly **61**.

Referring specifically to FIG. **10**, the stop-safe mechanism **140** (there is one on each side of the platen a assembly **40** but only one is shown) includes a row of precisely positioned apertures **190** (only one shown) in the index guide plates **155***a* and **155***b*, extending parallel to the longitudinal edge of the plates and, in the case of the plate **155***a*, parallel to the apertures **160**. The apertures **190** are precision machined in the plates **155***a* and **155***b* so that one of the apertures is in exact alignment with each row of terminals T, T_1 when the terminal plate P is mounted on the platen assembly **40**.

The stop-safe mechanism **140** includes a mechanism tower **191** which slidably mounts a locator pin **192** having a frusto-conical tip **193** formed on it. The pin **192** is connected, through a lost-motion linkage assembly **195**, with a cut-off switch assembly **196**. As the head assembly **61** descends, if the platen assembly **40** is in precisely the right position, as indexed by the indexing mechanism **135**, the pin **192** enters the appropriate aperture **190** and passes through it into a pin receiving sleeve **196**. Extending up into the sleeve **196** is a spring biased pin **197** which accomodates any slight overtravel of the pin **192**.

If the platen assembly is not in precise alignment for receipt of a prescribed row of terminals T and T_1 by the spindle wrenches **15** as the head assembly **61** descends, the pin **192** does not enter a corresponding aperture **190** but is, instead, forced upwardly by engagement with the surface of the corresponding guide plate **155***a* or **155***b*. Upward movement of the pin **192** causes the lost-motion assembly **195** to actuate the stop-switch assembly **196** and cut off power to the power train assembly **195**, thus stopping the descent of the head assembly **61**. It is thus assured that the machine **30** will operate to straighten each row of terminals in the plate P after engagement with them only when precise alignment for receipt of the terminals is established by the index mechanism **135** each time the platen assembly **40** is indexed.

I claim:

1. A method of changing the position of a bendable post and fixing the post in a prescribed new position, comprising the steps of:

a. bending said post into said new position from a position displaced therefrom, and

b. twisting the post generally about its axis whereby when it is released it remains in said new position.

2. The method of claim **1** further characterized by and including the step of:

a. holding said post in said prescribed new position while twisting it.

3. A method of straightening the wire wrap post of an electrical terminal seated in base means, whereby the post is moved from misalignment with a prescribed axis of the terminal to alignment therewith and fixed on said axis, comprising the steps of:

a. bending said post into alignment with said axis, and

b. twisting said post about said axis whereby when it is released it remains fixed on said axis.

4. The method of claim 3 further characterized by and including the step of:

a. twisting said post first in one direction about said axis and then in the opposite direction about said axis.

5. The method of claim 4 further characterized by and including the step of:

a. returning said post to generally its original radial orientation on said axis.

6. A method of straightening the wire wrap post of an electrical terminal seated in base means, whereby the post is returned from misalignment with the longitudinal axis of the terminal to alignment therewith and fixed on said axis, comprising the steps of:

a. bending said post into alignment with said axis,

b. twisting the post in one direction on said axis through a first predetermined number of degrees of arc from its original radial orientation on said axis,

c. twisting the post in the opposite direction on said axis through a second predetermined number of degrees of arc, and

d. returning said post to generally its original radial orientation on said axis by twisting it about said axis.

7. The method of claim 6 further characterized by and including the step of:

a. twisting the post in one direction through approximately 90° of arc from its original radial orientation on said axis.

8. The method of claim 7 further characterized by and including the step of:

a. twisting the post in said opposite direction on said axis through approximately 180° of arc.

9. The method of claim 8 further characterized by and including the step of:

a. returning said post to generally its original radial orientation on said axis by twisting it in said one direction on said axis through 70° to 110° of arc.

10. A method of straightening the elongated wire wrap post of an electrical terminal extending through a bushing seated in base means, whereby the elongated post is returned from misalignment with the longitudinal axis of the terminal to alignment therewith and fixed on said axis, comprising the steps of:

a. bending said post into alignment with stand axis,

b. twisting the post in one direction on said axis through a first predetermined number of degrees of arc from its original radial orientation relative on said axis,

c. twisting the post in the opposite direction on said axis through a second predetermined number of degrees of arc,

d. returning said post substantially to its original radial orientation on said axis by twisting it about said axis, and

e. distorting the metal of said post in each of said twisting steps only in an area immediately adjacent the bushing.

11. A method of straightening randomly positioned misaligned wire wrap posts of electrical terminals in a group of terminals seated in base means, whereby the misaligned posts are returned from misalignment with the longitudinal axes of corresponding terminals to alignment therewith and fixed on said axes, comprising the steps of:

a. gripping each wire wrap post in said group of terminals in such a manner that said misaligned wire wrap posts are bent into alignment with corresponding terminal axes and all the posts in said group are in alignment with corresponding axes,

b. twisting all of said posts in one direction on corresponding axes through a first predetermined number of degrees of arc from their original radial orientation on said corresponding axes,

c. twisting all of said posts in the opposite direction on said corresponding axes through a second predetermined degrees of arc, and

d. returning all of said posts to their generally original radial orientation on said corresponding axes by twisting them a about said corresponding axes.

12. The method of claim 11 further characterized by and including the step of: 11

a. twisting all of said posts in one direction through approximately 90° of arc from their original radial orientation on corresponding axes.

13. The method of claim 12 further characterized by and including the step of:

a. twisting all of said posts in said opposite direction on corresponding axes through approximately 180° of arc.

14. The method of claim 13 further characterized by and including the step of:

a. returning all of said posts to generally their original radial orientation on said corresponding axes by twisting them in said one direction on said corresponding axes through 70° to 110° of arc.

* * * * *

Notice of Adverse Decision in Interference

In Interference No. 98,288, involving Patent No. 3,700,011, G. Walter, TERMINAL STRAIGHTENING METHOD AND MACHINE, final judgment adverse to the patentee was rendered Aug. 23, 1974, as to claims 1, 2 and 3.

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