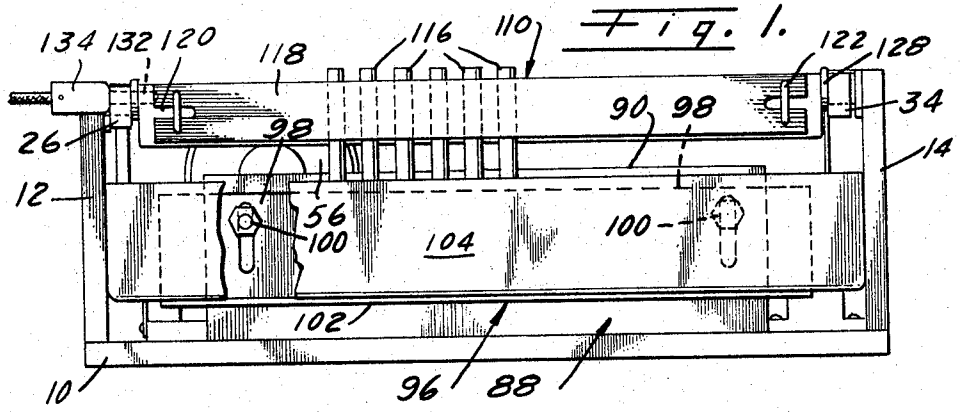
July 25, 1967 J. H. BENT ET AL 3,332,869

NEEDLE TAPERING APPARATUS

Filed Oct. 5, 1964 3 Sheets-Sheet 1

Fig. 1.



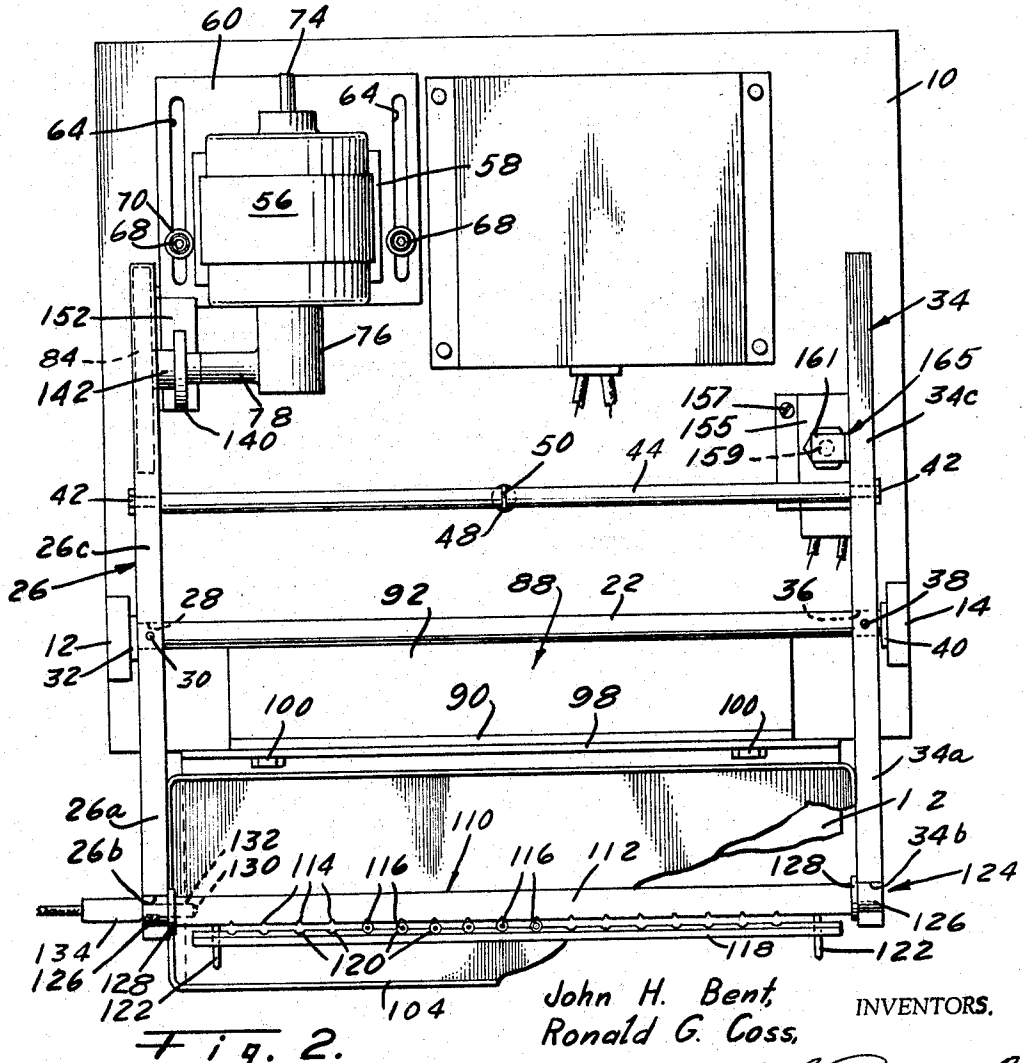


Fig. 2.

John H. Bent,
Ronald G. Coss,
INVENTORS.

BY J. C. Baird

Attorney

July 25, 1967 J. H. BENT ET AL 3,332,869

NEEDLE TAPERING APPARATUS

Filed Oct. 5, 1964 3 Sheets-Sheet 2

Fig. 3.

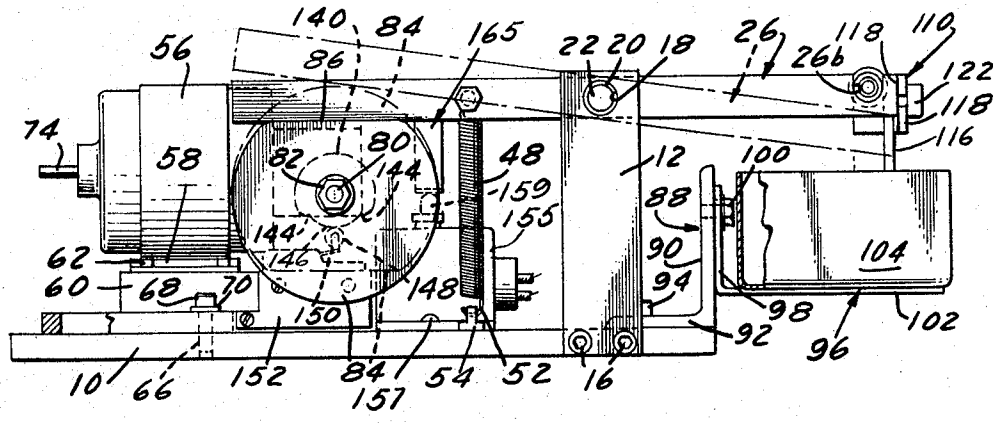


Fig. 4.

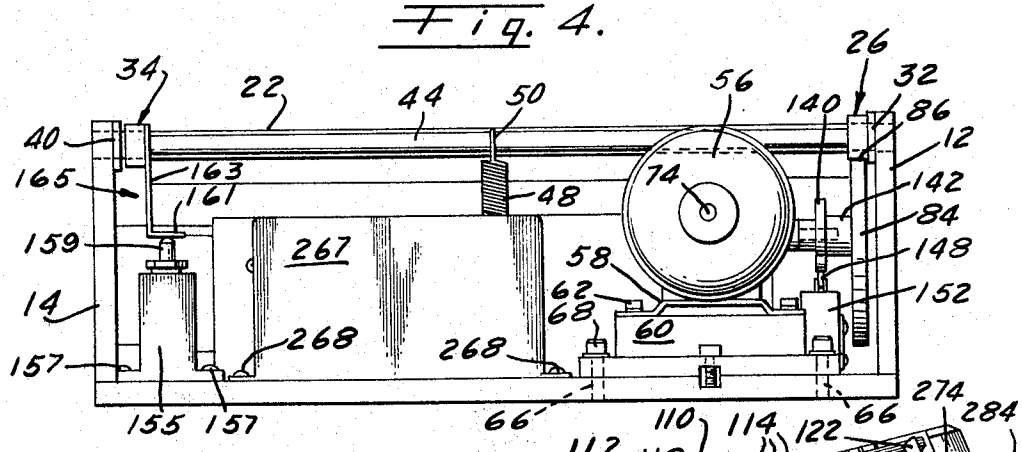
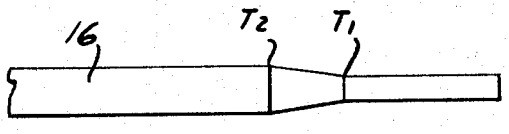


Fig. 5.

Fig. 6.



John H. Bent
Ronald G. Coss
INVENTORS.

BY J. C. Baird

Attorney

July 25, 1967 J. H. BENT ET AL 3,332,869

NEEDLE TAPERING APPARATUS

Filed Oct. 5, 1964 3 Sheets-Sheet 3

Fig. 7.

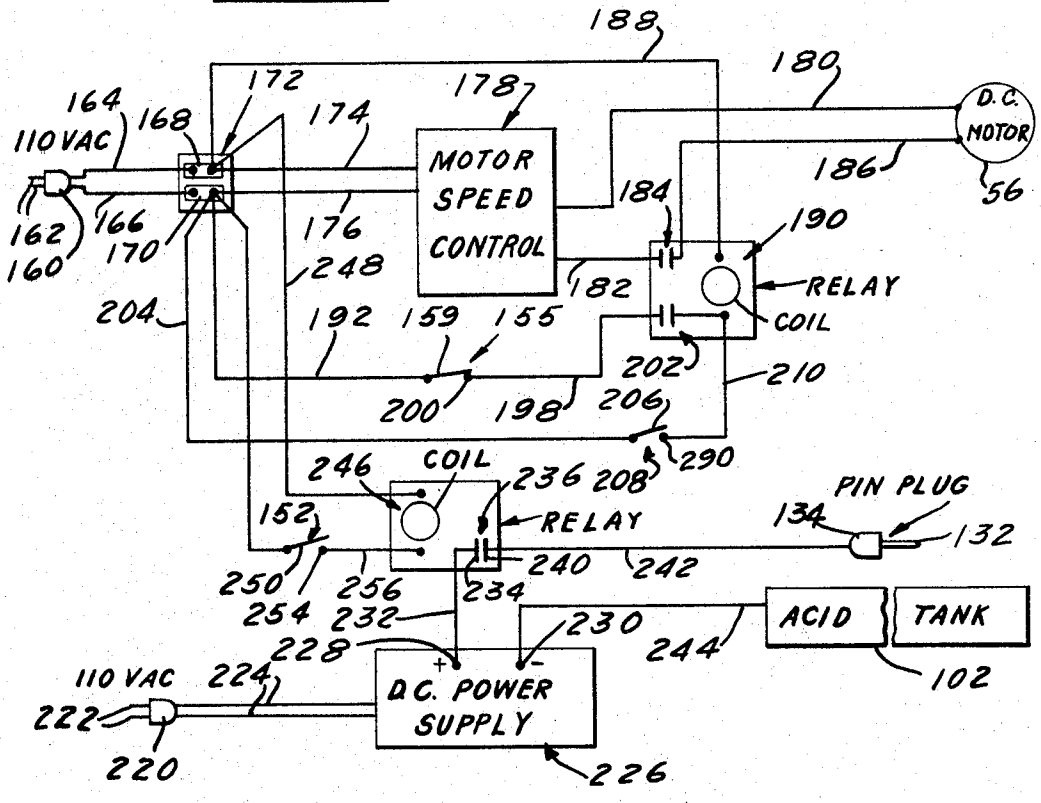
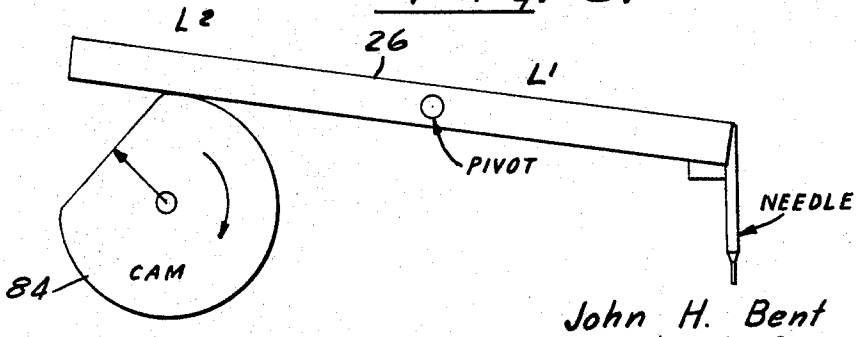


Fig. 8.



John H. Bent
Ronald G. Coss
INVENTORS.

BY J. H. Baisch

Attorney

United States Patent Office 3,332,869 Patented July 25, 1967

3,332,869

NEEDLE TAPERING APPARATUS

John H. Bent, Fullerton, and Ronald G. Coss, La Habra, Calif., assignors to Hamilton Company, Inc., Whittier, Calif., a corporation of California

Filed Oct. 5, 1964, Ser. No. 401,542
9 Claims. (Cl. 204—223)

This invention relates generally to means or apparatus for forming or shaping tubular needles and the like and relates more particularly to means or apparatus for tapering tubular needles and the like for scientific instruments.

While the invention has particular utility in conneciton with the forming of the shape or taper of the exterior of tubular needles for use in scientific work and the like, and is shown and described in this connection, it is to be understood that its utility is not confined thereto.

It is an object of the invention to provide apparatus and method for forming the exterior shape or taper of tubular needles for scientific work.

It is another object of the invention to provide apparatus of this character that will automatically form such needles.

It is still another object of the invention to provide apparatus of this character that will form the tip or free end portion of the needle with a reduced diameter tip end portion so that the needle will have a small penetrating end portion but will have the proper stiffness for delicate manipulation necessary in experimental biology, entomology, medicine and other scientific work.

Still another object of the invention is to provide apparatus of this character that will electrolytically form needles that have a smooth electropolished surface.

A further object of the invention is to provide apparatus of this character that will produce needles that will not damage rubber dams and the like to the extent other methods and apparatus do.

A still further object of the invention is to provide apparatus of this character that will provide needles of extremely smooth surfaces and eliminate sharp radiuses at the ends of the tapered portion.

Another object of the invention is to provide apparatus of this character having means for controlling the angle and shape of the needles.

Still another object of the invention is to provide apparatus of this character that is simple in construction.

A further object of the invention is to provide apparatus of this character that is reliable and effective in operation.

A still further object of the invention is to provide apparatus of this character that is relatively inexpensive to manufacture.

Another object of the invention is to provide apparatus of this character that is easy and simple to operate and maintain.

The characteristics and advantages of the invention are further sufficiently refered to in connection with the following detailed description of the accompanying drawings, which represent one embodiment. After considering this example, skilled persons will understand that variations may be made without departing from the principles disclosed and we contemplate the employment of any structures, arrangements or modes of operation that are properly within the scope of the appended claims.

Referring to the drawings, which are for illustrative purposes only:

FIG. 1 is a front view of apparatus embodying the present invention;

FIG. 2 is a top plan view of said apparatus;

FIG. 3 is a view of one end of the apparatus;

FIG. 4 is a view of the opposite end thereof;

FIG. 5 is a perspective view of the means for holding the needles while they are being shaped;

FIG. 6 is an enlarged side view of the formed end of a needle;

FIG. 7 is a diagram of the electrical system of the apparatus; and

FIG. 8 is a diagrammatic view showing the cam operation.

Referring more particularly to the drawings, there is shown apparatus embodying the present invention, said apparatus having a base **10** which is of electrical insulating material. At opposite sides and adjacent the front of the base are a pair of upstanding support members **12** and **14** respectively, the lower ends of said support members being secured to the base by means of screws **16**.

Support members **12** and **14** are provided with bores **18** adjacent their upper ends, said bores being axially aligned relative to each other and provided with bearings **20** which are secured therein by any suitable means such as press fitting. End portions of a shaft **22** are pivotally disposed in said bearings.

Adjacent one of the upright support members, the member **12**, is mounted a cam follower arm **26**. This follower arm is provided with a bore **28** therethrough intermediate its ends for reception of the shaft **22** and the follower arm **26** is secured to said shaft by any suitable means such as a pin **30** which is fixed in openings provided therefor in the follower arm and an aligned opening in the shaft **22**. A spacer or washer **32** is disposed on the shaft **22** between the follower arm **26** and the adjacent side of the upright member **12**.

Adjacent the upright support member **14** a rocker arm **34** is mounted on said shaft **22**, said rocker arm having a bore **36** therethrough for reception of said shaft **22** and is secured to said shaft by a pin **38** fixed in openings provided therefor in said rocker arm and an aligned opening in said shaft, there being a washer or spacer **40** disposed on shaft **22** between said rocker arm and support member **14**. Thus the cam follower arm **26** and the rocker arm **34** are fixed on shaft **22** for simultaneous movement therewith, said cam follower arm and rocker arm being aligned with each other, there being forwardly extending parts **26***a* and **34***a* of said follower arm and rocker arm respectively which are of the same length and which have upwardly opening notches **26***b* and **34***b* respectively in the upper sides and adjacent the forward free ends thereof, said notches being semicylindrical at the bottom for a purpose hereinafter described.

Both the follower arm and the rocker arm have rearwardly extending parts **26***c* and **34***c* and there are aligned laterally extending axially aligned openings therein for reception of screws **42** which have their inner ends screwed into tapped openings provided therefor in the adjacent ends of a brace **44** which braces the rearwardly extending parts **26***c* and **34***c* of the follower arm and rocker arm and holds same against any wobbling or misalignment on the shaft **22**.

There is means for yieldingly urging the rearwardly extending parts **26***c* and **34***c* of the follower arm and the rocker arm downwardly so as to urge said arms in the counterclockwise direction, as viewed in FIG. 3. This means comprises a spring **48** having one end, **50**, formed in a ring for reception of the shaft **22**. The opposite end of the spring is formed into a hook **52** which is disposed in an opening provided therefor in a bracket **54** secured to the base **10** by any suitable means, such as screws or the like, not shown.

Mounted adjacent the rear of the base **10** and adjacent the side having the cam follower is an electric motor

56 having the usual support plate 58 at the bottom which is secured to a motor base 60 by means of screws 62. The motor base 60 is provided with a pair of slots 64 which are adjacent the sides of said motor base in parallel relationship and which extend longitudinally of the motor base and base 10 of the apparatus. This is an upstanding screw 66 for each slot, said screws being threadably received in tapped bores provided therefor in the base 10. The screws extend through the slots 64 and have heads 68 at their upper ends for releasably securing the motor base 60 in adjusted positions. Washers 70 are disposed between the screw heads 68 and the motor base 60.

Motor 56 has the usual shaft 74, the forward end of which extends into a gear box 76 at the forward end of said motor. The gear box 76 has a lateral extension 78 through which a shaft 80, FIG. 3, extends and which is rotatable therein. Gearing, not shown, are operably disposed for operably connecting the shaft 74 of the motor with the shaft 80, said gearing being of well known character and need not be described.

Secured on the free end of shaft 80 by means of a screw 82 screwed into a tapped bore provided therefor in the outer end of shaft 80 is a symmetrical point cam 84 which is eccentrically disposed on shaft 80 and which has a flat portion 86. As shown, the flat portion 86 is normal to a diametrical line extending through the axial center of the cam and the axis of the shaft 80 and at the side of the offsetting of said cam. However, it is to be understood that the cam may be of any suitable character for a particular type of work and mounted on shaft 80 in any suitable position, for such type of work. The axis of cam 84 is normal to the plane of the follower arm 26 and said arm operably engages the upper edge of said cam, being yieldingly urged into such operable engagement by the spring 48. The offsetting of the cam on the shaft 80 is to produce the taper in the needles as will be described more fully hereinafter. At the forward end of the base 10 there is an L-shaped tank bracket, indicated generally at 88, which has an upstanding arm 90 and arm 92 which extends rearwardly from the lower end of the arm 90. Screws 94 secure the arm 92 to the top side of the base 10.

A tank support bracket, indicated generally at 96, has an arm 98 attached by means of screws 100 to the upstanding arm 90 of the tank bracket 88, said tank support bracket having an arm 102 extending forwardly from the lower end of the arm 98 and on which a tank 104 is supported, said tank being for an electrolyte or electrolytic solution. A suitable electrolyte has been found to be a chromic acid solution, the chemical composition of 100 ml. of liquid is 10 grains of chromic anhydride, 1 grain of sulfuric acid. Tank 104 extends transversely of the base and beneath the free ends of the follower arm 26 and the rocker arm 34.

There is a needle holder, indicated generally at 110, which includes an elongated body 112 the forward face of which is provided with a plurality of transversely extending, longitudinally spaced grooves 114, FIGS. 2 and 5, of generally V-shape for reception of upper portions of untapered or formed tubular needles 116, FIGS. 1 and 2 and 3, said unformed needles being termed needle blanks for convenience. The needles are clamped to the body 102 of the needle holder by a clamp bar 118 which has notches 120 which extend inwardly of the ends of the clamp bar and in which are received winged screws 122 which are threadably disposed in tapped bores, not shown, in the body 102.

There is a tapped bore which extends inwardly from the free ends of the body 102 and in axial alignment with each other, for reception of threaded end portions, not shown, of extensions, indicated generally at 124. These extensions have outwardly extending stub shafts 126 and an enlarged collar 128 at their inner ends. In other words the collars are located intermediate the ends of the extensions 124. The stub shafts 126 are adapted to be removably disposed in the respective notches 26*b* and 34*b* of the follower arm 26 and the rocker arm 34 and said stub shafts will pivot or rotate a limited amount in said notches, the bottoms of which support said stub shafts and serve as bearings therefor. The extensions 124 may be of any suitable material, preferably a nonconductor of electricity. An example of one material that may be used is Nylon.

One of the extensions is longitudinally bored and there is a bore 130 in the adjacent end of the body 102 of the needle holder which is aligned with the bore in the one extension so that the contact end 132 of a pin plug 134 may be inserted through the bore of said extension and into the bore 130 in said body 102 to thereby supply electric current to said body and thence to the needles clamped thereto.

The needle holder has sufficient weight below the axis of the stub shafts so that the lower ends of the needles clamped therein will extend downwardly for immersion in the electrolyte in the tank 104, it being noted that said tank is of suitable material to handle electrolyte and is, of course, of electrically conducting character. One material that has been found suitable is stainless steel.

Also rotatably operated by the shaft 80 is a switch cam 140 which is part of a sleeve 142 secured to the shaft 80 by any suitable means such as a key, not shown, so that said switch cam is properly correlated to or positioned relative to the cam 84. Cam 140 is provided with relieved parts 144 at each side of an intermediate cam part 146 and said cam 140 is adapted to be engaged by a roller 148 operably mounted at the free end of a switch arm 150 of a timing switch 152 secured to the base 10 by screws or the like, not shown.

There is also a normally closed system switch 155 secured to the base 10 by means of screws 157 and having a movable switch member 159 adapted to be actuated by the laterally turned arm 161 at the lower end of an arm 163 of a system switch actuating bracket, indicated generally at 165, the upper end of said arm 163 being connected or secured to the rearward part 34*c* of the rocker arm 34 by any suitable means such as screws or the like, not shown. When the rear part 34*c* of the rocker arm 34 is at its lowermost position as at the start of a cycle of the apparatus the movable switch member is in a position whereat the switch 155 is open. Small upward movement of the part 34*c* of said rocker arm allows the switch member 159 to move upwardly so that switch 155 is closed. At the end of a cycle the rocker arm part 34*c* returns to its lowermost position and effects opening of switch 155.

The wiring system of the apparatus is shown in FIG. 7. As shown there are two electrical circuits, one for the electric motor 56 and the other for the electrolytic portion.

As to the motor circuit, there is a plug 160 for plugging into a 110 volt A.C. line. Plug 160 has two prongs 162 to which the plug ends of wires 164 and 166 are connected and which have their other ends connected to terminal strips 168 and 170 of a terminal box, indicated generally at 172.

From the terminal strips 168 and 170 wires 174 and 176 lead to a motor speed control 178 which may be of any well known type and need not be described further. A wire 180 leads from the motor speed control to the motor 56 which is a direct current motor. A wire 182 leads from the motor speed control to one of the contacts of a normally open switch 184, there being a wire 186 leading from the other contact of said switch 184 to said D.C. motor 56.

From terminal strip 168 there is a second wire, wire 188, which is operably connected to the coil of a relay 190.

There are two lines from the terminal strip 170 to the coil of relay 190, said lines being in parallel with each other. One of these lines includes wire 192 leading to one contact, shown as movable contact 159 of the normally closed system switch 155. A wire 198 from fixed contact

200 of said switch 155 is operably connected to one of the contacts of a normally open switch 202 which has its other contact connected to the coil of relay 190 which is adapted to operate to close the contacts of switches 184 and 202.

The second line from terminal strip 170 to the coil of relay 190 includes wire 204 which is connected to a contact, movable contact 206, of a foot actuated switch, indicated generally at 208. From the fixed contact 290 of said switch 208, a wire leads to and is operably connected to the relay 190.

The electrical system for the electrolytic part of the apparatus has a plug 220 provided with two prongs 222 for plugging into a source of electric power which is shown as 110 volt A.C. source. Wires 224 have their plug ends connected to respective prongs and their other ends connected with a rectifier, indicated generally at 226, which has plus (+) and minus (−) outlet terminals 228 and 230 respectively. The plus terminal is connected by a wire 232 to a contact 234 of a normally open relay operated switch, indicated generally at 236. The other contact, contact 240 of said relay operated switch is connected by a wire 242 with the pin plug 134. The minus (−) terminal 230 of said rectifier 226 is connected to the acid tank 104 by a wire 244.

The terminal strip 168 of the motor system or circuit is operably connected to a relay 246 by means of a wire 248 while the terminal strip 170 is connected to a contact, movable contact 250, of the normally open timing switch 152. From fixed contact 254 of switch 152 a wire 256 leads to the relay 246.

Relay 190 is energized by closing the normally open foot switch 208 which is held closed until the rear part 34c of rocker arm 34 has moved upwardly sufficiently for closing of the system switch 155 after which said foot switch 208 may be released. Energization of relay 190 effects closing of switches 184 and 202, and since switch 155 is now closed, current is supplied to the relay 190 by way of the line which includes said system switch 155 to keep said relay 190 energized and switches 184 and 202 closed. At the same time the motor 56 is energized and remains so as long as relay 190 is energized.

Certain of the electrical components such as the relays with their switches, the rectifier 226 and the motor speed control are disposed within the housing 267 removably secured to the base by screws 268.

Various means may be employed for loading the needle holder, one such means being shown in FIG. 5 and comprises a loading rack, indicated generally at 270, said rack comprises an elongated body 272 with a front face 274 which slopes upwardly and rearwardly. At the top of the rack body is a groove, indicated generally at 276, extending longitudinally of the body at the upper end of the face 274. The bottom wall 278 of the groove 276 is normal to the face 274 and the back wall 280 of said groove is normal to said bottom wall 278 and in a plane parallel to the plane of the front face 274.

The bottom wall 278 is of substantially the same width as the thickness of the body 102 of the needle holder and when the latter is placed in said groove 276 the upper, transversely grooved face of said body is in substantially the same plane as the plane of the face 274 of the loading rack.

On the front face 274 of the loading rack there is an adjustable needle positioning bar 282 having pivotal connections 284 adjacent its ends with links 286 adjacent the upper ends thereof, the opposite ends of said links 286 being pivotally mounted on screws 290 having their inner ends screwed into tapped bores provided therefor in the front of the body 272 of the loading rack. Adjustment of the bar 282 is effected by loosening the screws 290 and positioning the bar 282 at a predetermined position and then tightening said screws. Bar 282 is always maintained parallel to the upper edge 292 of the face 274 and serves as a stop or rest for the lower ends of the needles 116 to be tapered or formed, the needles being placed in respective grooves 114 of the body of the needle holder when the clamp bar 118 has been removed. After the needles have been placed in position the clamp bar 118 is placed over them and tightened by means of the screws 122 of the needle holder which is then placed in position at the front ends of the follower and rocker arms with the stub shafts thereof in the notches 26b and 34b.

The free end portions of the needles or needle blanks depend straight down from the needle holder and are maintained in a vertical position due to the weight of the needle holder below the axis of the stub shafts being greater than the weight above said axis, there being rotation of said stub shafts in said notches 26b and 34b as the front end portions 26a and 34a of the follower and rocker arms are moved upwardly and downwardly by the cam 84. With this upward and downward movement the lower ends of the needles are dipped or immersed in the electrolyte in the tank 104.

At the start of a cycle the flat 86 of the point cam 84 is at the top, as best shown in FIGS. 3 and 4, and the switch cam 140 has its lobe 146 at the bottom.

The motor is started by energizing the relay 190, this being effected by closing the normally open foot switch 208. Energization of the relay 190 effects closing of the switches 184 and 202 and when said relay has been energized and the switch 155 opened with upward movement of the rear rocker arm portion 34c the foot switch 208 may be released as the switches 184 and 202 will be kept closed by the relay. Closing of switch 184 completes the current to the motor 56 while closing of switch 202 completes the circuit to the coil of relay 190.

When the switch cam 140 is positioned as shown in FIGS. 3 and 4, the switch 152 is in the off position. As the motor rotates the point cam 84 and the switch cam 140, the rear portion of the follower and rocker arms are raised by action of the point cam 84. This moves the lower ends of the needles downwardly into the electrolyte. No current is supplied to the tank and the needle holder body until the needles have been lowered into the electrolyte to a predetermined point, T^1, FIG. 6, where the lower end of the tapered part T is. The timing switch 152 is then closed by its cam 140. Continued operation of the motor causes the needles to be further immersed in the electrolyte to the point T^2 which is the upper end of the tapered part T. When the needles have been immersed to point T^2 the point cam 84 starts to raise the needle holder and needles by reason of the formation of said point cam. When the needles have been raised to the point T^1 the lower end of the taper T the switch 152 is again opened by its cam 140 so that current is cut off to the tank and needle holder body. The motor however, continues to operate and raise the needles out of the electrolyte and when the cycle is complete, with the flat 86 of the cam 84 at the starting position, as shown in FIGS. 3 and 4, the switch 155 is opened by the switch operating bracket 165 thereby deenergizing relay 190 and opening switches 184 and 202. The needles thus formed have a fine electropolished finish.

The point cam 84 is rotated slowly by the electric motor 56, the speed depending on the type of electrolyte or electrolytic solution used and its strength. This speed of cam rotation is in the neighborhood of one revolution in a minute and a half (1½ minutes). However, the speed may be varied by the motor speed control means 178 to meet specific requirements.

Referring to FIG. 8 there is diagrammatically shown the relationship between the point cam 84, the needles and the interconnecting lever. The follower arm 26 is indicated here but represents also the rocker arm 34.

In this view the point cam 84 is rotated in the direction indicated by the arrow and when in the position shown the breakaway and stop position is coming up.

Adjustment of the motor and point cam 84 forwardly

and rearwardly varies the point of engagement of the cam and the part of lever **26** and thereby varies the length of the tapered part of the needles. The motor and cam adjustment is made by loosening the screws **68** in the slots in the motor base and moving the motor and cam forwardly or rearwardly in accordance with the length of needle taper desired. The screws **68** then being tightened to hold the motor and cam in the adjusted position.

The invention and its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts of the invention without departing from the spirit and scope thereof or sacrificing its material advantages, the arrangement hereinbefore described being merely by way of example, and we do not wish to be restricted to the specific form shown or uses mentioned except as defined in the accompanying claims, wherein various portions have been separated for clarity of reading and not for emphasis.

We claim:

1. In apparatus for forming tubular needles and the like:

(A) a support base of insulating material;

(B) a pair of upright shaft support members secured to opposite sides of said base;

(C) a shaft having its ends pivoted to said support members;

(D) a cam follower arm secured intermediate its ends to said shaft with a part extending forwardly of said shaft and a part extending rearwardly thereof;

(E) a rocker arm secured intermediate its ends to said shaft with a part extending forwardly of said shaft and a part extending rearwardly thereof, the forwardly extending parts of said arms having upwardly opening notches spaced equal distances forwardly of said shaft;

(F) yielding means urging the rear end parts of said arms downwardly and the forward portions upwardly;

(G) a needle holder including

(a) a body extending between the forward ends of said arms, said body having vertically extending longitudinally spaced needle receiving grooves,

(b) stub shafts at the ends thereof for removable reception in said notches, said stub shafts being of insulating material,

(c) a releasable clamp bar for clamping needles in said grooves,

(d) said needle holder having a greater part of its weight below the axis of said stub shafts,

(e) said body having a socket at one end;

(H) an electric motor mounted on said base;

(I) a point cam driven by said motor and operably engaged by the rearwardly extending part of the follower arm;

(J) a timing cam driven by said motor;

(K) means for adjusting said motor forwardly and rearwardly relative to said follower arm;

(L) a tank for an electrolyte solution, said tank being positioned beneath the needle holder;

(M) and an electrical system including

(a) a motor control circuit adapted to be connected to a suitable source of electric current, said motor circuit including

(1) speed control means for said motor,

(2) a normally open motor switch for controlling current to said motor;

(b) a relay mechanism having one

(1) one connection with one side of a source of electric current

(2) a connection with the other side of said electric current, the latter connection including a normally open relay switch closed when the relay is energized

(3) said relay, when energized, also closing said motor switch,

(4) said relay connection with the other side of said source of electric current having a normally closed system switch,

(5) a second relay connection with said other side of said source of current in series with the first mentioned relay connection and including a normally open manually operated switch

(6) said system control switch being closed by the rocker arm when the rear portion is at its lowermost position,

(c) and a circuit for the electrolytic part of the apparatus, said circuit including positive and negative sides with the negative side connected with the tank for the elctrolyte, the positive side including

(1) a plug for the socket in the body of the needle holder,

(2) and a relay mechanism including a normally open timing switch controlling the line to the plug,

(3) said timing switch being operated and controlled by the timing cam.

2. In apparatus for forming tubular needles and the like:

(A) a tank for an electrolytic solution;

(B) needle holding means for holding a plurality of needles;

(C) means, including a point cam, for raising and lowering said needle holder relative to said tank for immersing the lower ends of needles held by said needle holding means into and out of an electrolytic solution in said tank;

(D) an electric motor for operating said point cam;

(E) an electrical system for said motor, including

(a) a relay having a normally open motor control switch and a normally open relay control switch, said switches being operated by said relay,

(b) said relay having one connection with said source of electric power, said connection including a normally open manually actuated switch, and

(c) a second connection with the same side of said source of electric power, said second connection including a normally open system switch in series with said relay switch

(d) and motor speed control in the motor circuit;

(F) an electrolysis circuit including a positive side connected with the needle holder and a negative side connected with the electrolytic solution,

(a) a relay, including a first normally open timing switch, for controlling the positive side of the electrolysis circuit,

(b) an electrical circuit for the last mentioned relay, said circuit including

(1) a second normally open timing switch;

(G) a timing cam driven by said electric motor for controlling said second timing switch so as to maintain said timing switch open while the needles are being immersed in the electrolytic solution to a predetermined point, allowing said switch to close from that point of needle immersion to a second predetermined point of greater amount of needle point immersion and retraction of the needles to the first predetermined point of immersion and then opening said second timing switch;

(H) and means for opening said system switch when the needle holding means has been raised to a point whereat the depending points of the needles are out of the electrolytic solution.

3. In apparatus for forming tapers on tubular needles and the like:

(A) a tank for an electrolytic solution;
(B) needle holding means for holding a plurality of needles;
(C) means, including a point cam, for raising and lowering said needle holder relative to said tank for immersing lower end portions of said needles held by said needle holding means into and out of an electrolytic solution in said tank;
(D) an electric motor for rotating said cam at a predetermined slow speed;
(E) an electrical system for said motor mechanism including
(a) a relay mechanism including a normally open motor control switch and a normally open relay switch, said switches being operated by said relay,
(b) said relay having one connection adapted to be connected with one side of a source of electric power, said connection including a normally open manually operable switch, and
(c) a second connection adapted to be connected with the same side of said source of electric power, said second connection being in series with said one connection and including a normally open system switch,
(d) a relay being adapted also to be connected with the other side of said source of power,
(e) and motor speed control means in said motor circuit;
(F) an electrolysis circuit including a positive side connected with the needle holding means and a negative side connected with the electrolytic solution in the tank,
(a) a relay, including a normally open timing switch, for controlling the positive side of the electrolysis circuit,
(b) an electrical circuit for the last mentioned relay, said circuit including a normally open timing switch;
(G) a timing cam driven by said electric motor for controlling the timing switch in a sequence whereat said timing switch is open while the needles are being immersed in the electrolytic solution to a predetermined point, said switch is closed from that point of needle immersion to a second predetermined point of greater needle point immersion and retraction of the needles to the first point of immersion, said timing switch then being opened;
(H) and means for opening said system switch when the needle holding means has been raised to a point whereat the depending points of the needles are out of the electrolytic solution.

4. The invention defined by claim **3** wherein said point cam has a flat portion and the axis of said cam is offset away from said flat portion.

5. In apparatus for forming tapers on tubular needles and the like:
(A) a tank for an electrolytic solution;
(B) needle holding means for holding a plurality of needles;

(C) means, including a point cam, for raising and lowering said needle holder relative to said tank for immersing lower end portions of said needles held by said needle holding means into and out of an electrolytic solution in said tank;
(D) an electric motor for rotating said cam at a predetermined speed;
(E) an electrical system for said motor;
(F) an electrolysis circuit for electropolishing needles immersed in said electrolytic solution;
(G) and means synchronized with said point cam including a timing cam driven by said electric motor, for allowing the flow of the current for electroetching the needles when said needles are immersed in said solution to a first predetermined point and continuing said current flow from that first point to a second point of deeper immersion and retraction of the needles to said first predetermined point, and interrupting said flow of said current flow at said first point during said retraction.

6. The invention defined by claim **5** including means for automatically stopping the electric motor when a cycle of operation has been completed.

7. In apparatus for forming tapers on a needle or the like:
(A) a tank for an electrolytic solution;
(B) needle holding means for holding a needle;
(C) means, including a cam, for raising and lowering said needle holder relative to said tank for immersing lower end portion of said needle held by said needle holding means into and out of an electrolytic solution in said tank;
(D) means for rotating said cam at a predetermined speed;
(E) and means synchronized with said cam for allowing the flow of the current for electroetching the needles when said needles are immersed in said solution to a first predetermined point, and continuing said current flow from that first point to a second predetermined point of deeper immersion and retraction of the needles to said first predetermined point, and interrupting said current flow at said first point during said retraction.

8. The invention defined by claim **7** wherein the cam surface of said cam includes a flat portion, said cam being symmetrical.

9. The invention defined by claim **8** wherein said cam is axially offset.

References Cited

UNITED STATES PATENTS

1,865,767	7/1932	Kirchner	204—223
2,385,198	9/1945	Engle	204—224
2,628,936	2/1953	Albano	204—142
2,865,125	12/1958	Lanesfeld	204—142
3,202,595	8/1965	Inoue	204—143

J. H. MACK, *Primary Examiner.*

R. K. MIHALEK, *Assistant Examiner.*