Aug. 17, 1954

A. GREINER ET AL

2,686,539

COIL BENDING MACHINE FOR MONOPLANE PROJECTION LAMP FILAMENTS

Filed April 29, 1953

4 Sheets-Sheet 1

Fig. 1.

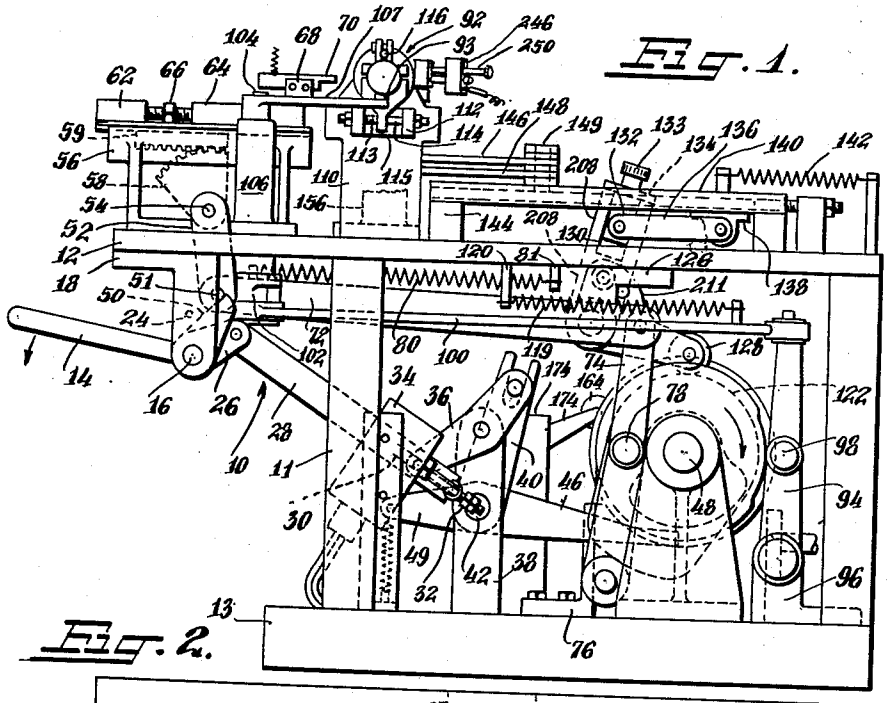
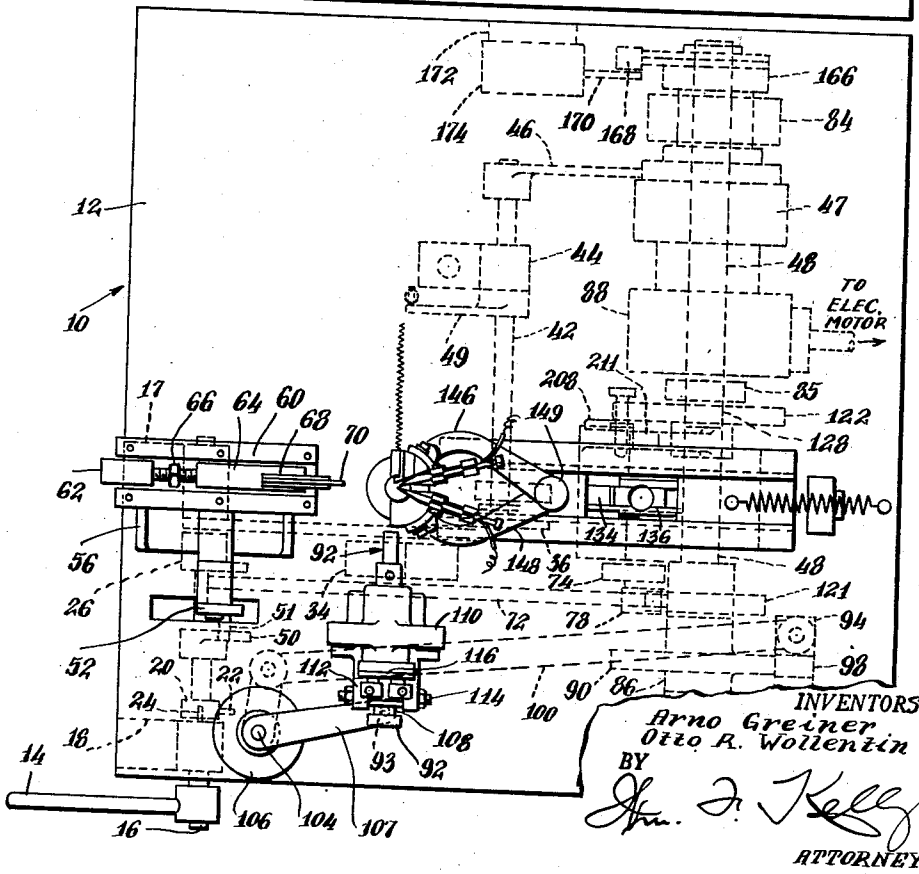


Fig. 2.



INVENTORS.
Arno Greiner
Otto A. Wollentin
BY
ATTORNEY.

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4 Sheets-Sheet 2

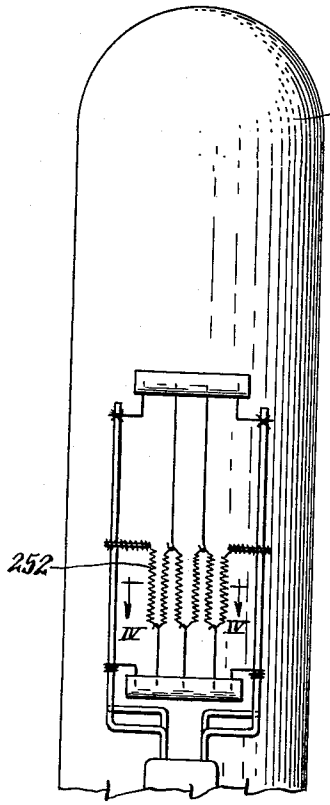


Fig. 3.



Fig. 4.

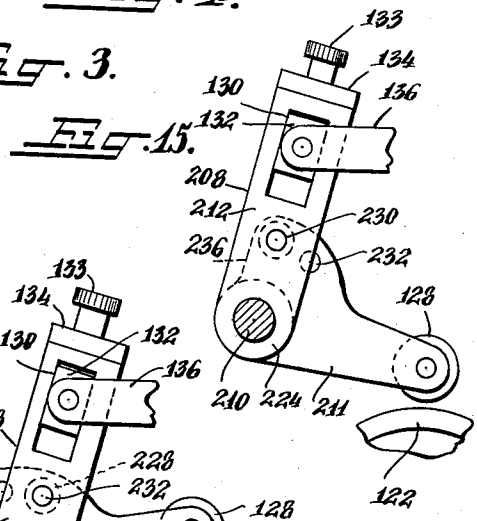


Fig. 15.

Fig. 16.

Fig. 17.

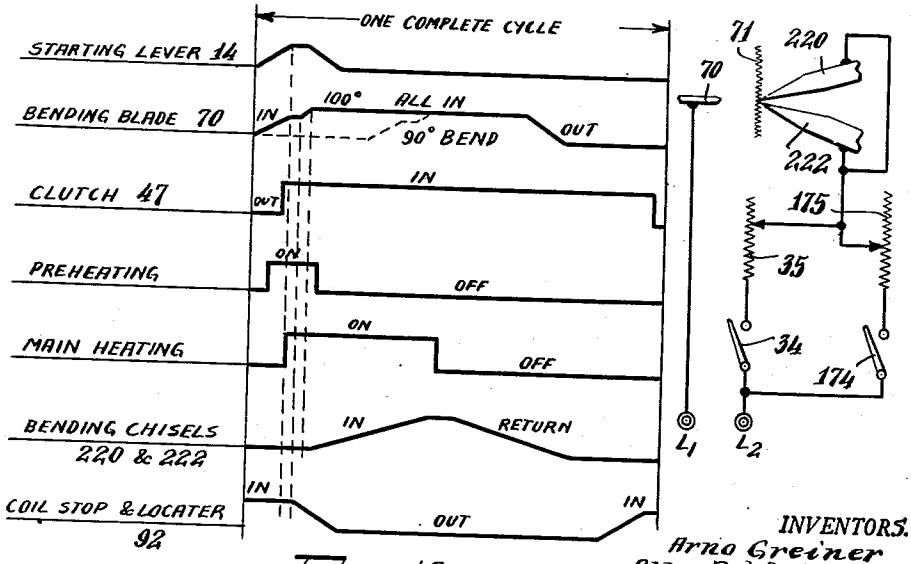


Fig. 18.

INVENTORS.
Arno Greiner
Otto R. Wollentin
BY
Jno. J. Kelly
ATTORNEY

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A. GREINER ET AL

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Fig. 5.

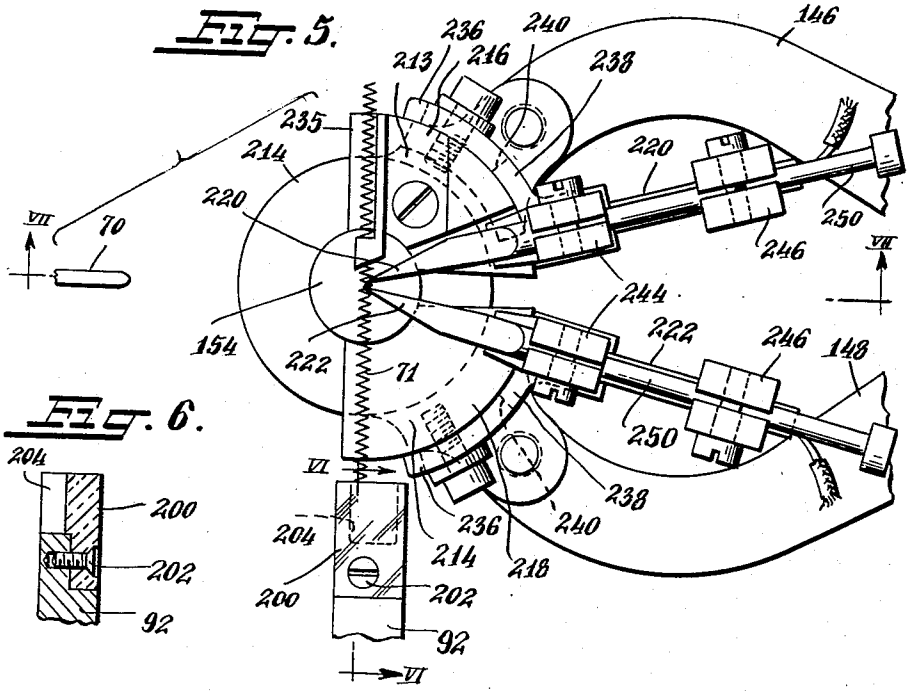
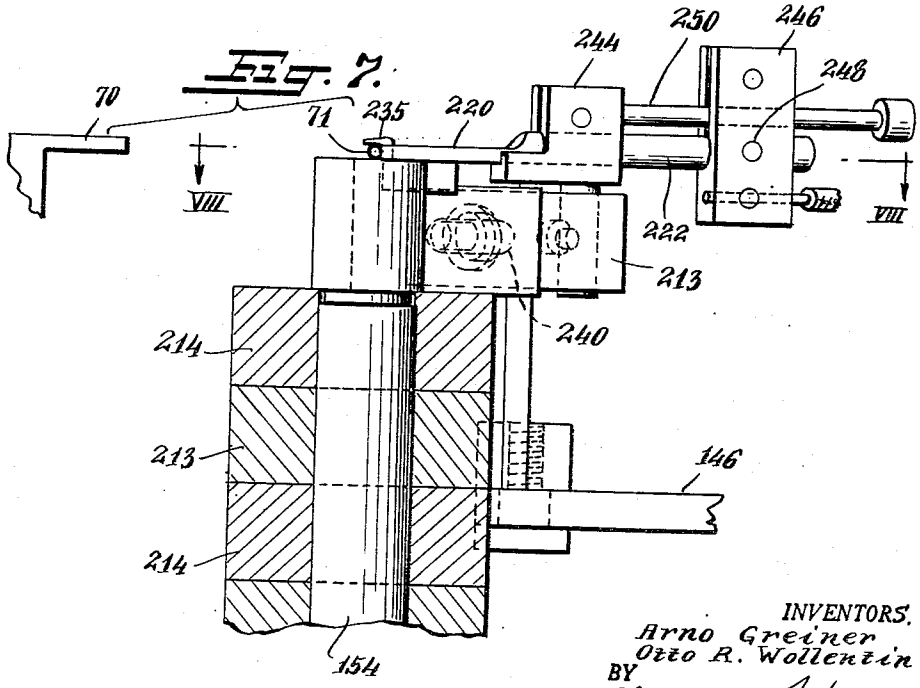


Fig. 6.

Fig. 7.



INVENTORS.
Arno Greiner
Otto R. Wollentin
BY
Jno. F. Kelly
ATTORNEY.

Aug. 17, 1954

A. GREINER ET AL

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Fig. 8.

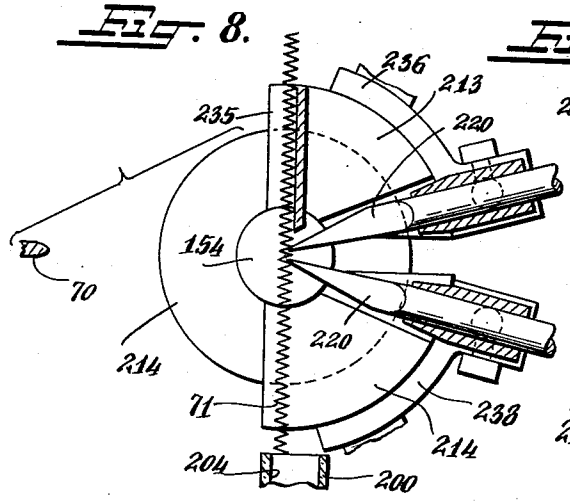


Fig. 9.

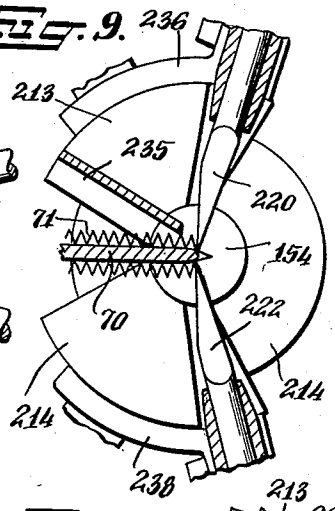


Fig. 10.

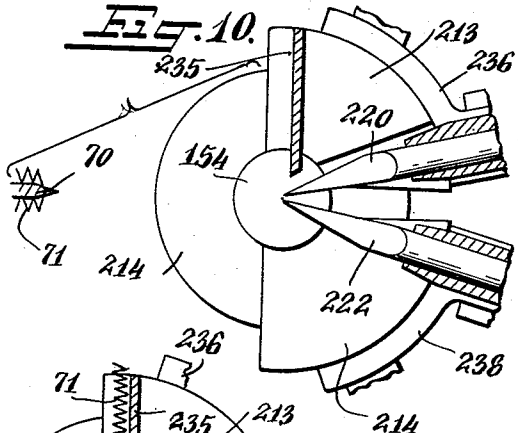


Fig. 11.

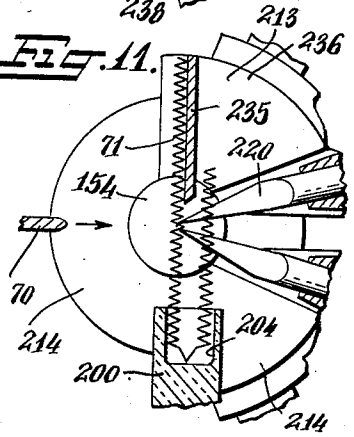


Fig. 12.

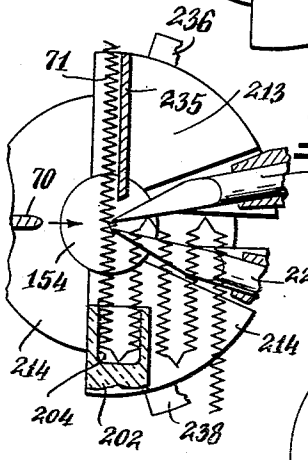


Fig. 14.

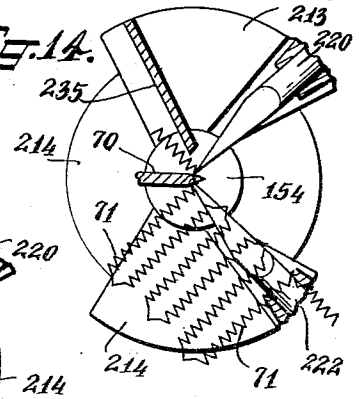
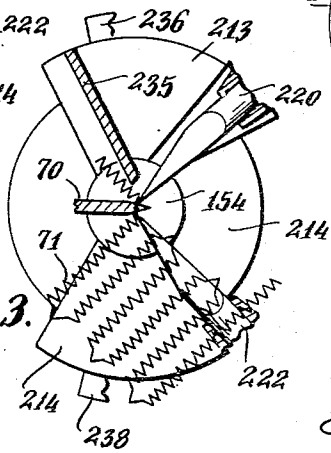


Fig. 13.



INVENTORS.
Arno Greiner
Otto R. Wollentin
BY
ATTORNEY

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UNITED STATES PATENT OFFICE

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COIL BENDING MACHINE FOR MONOPLANE PROJECTION LAMP FILAMENTS

Arno Greiner, Irvington, and Otto R. Wollentin, East Keansburgh, N. J., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application April 29, 1953, Serial No. 351,952

4 Claims. (Cl. 140—71.5)

1

This invention relates to the manufacture of incandescent lamps and, more particularly, to a coil bending machine for monoplane projection lamp filaments.

The objective in the design of projection lamps is to fill the aperture of a projection system with a light source of high brightness and maximum uniformity. This is accomplished by arranging the filament coils in a single or double vertical plane, accurately located with respect to the optical system by a prefocused base. The bi-plane filament, with coils arranged in two parallel rows so placed that the coils in one row fill in the spaces between those of the other, has much greater uniformity and higher average brightness than the single row monoplane filament. However, where decreased cost is an important factor and in slide projector applications where it is desirous to spread the light over relatively large areas through the use of a tilted spherical mirror to thus produce greater efficiency, the monoplane filament is generally employed.

The monoplane filament for a conventional electric lamp, such as a projection lamp, is generally formed from a continuous coil into a multi-section filament, having for example six sections. The first and last sections are bent longer than the second, third, fourth and fifth or inner sections, so that a secondary right angle bend may be made therein to provide filament mounting legs. These secondary bends are made at a desired point in said sections (the same relative location as the bending point of the center sections), to form the filament leg portions perpendicular to the parallel center sections of the filament.

The purpose of this invention is to provide a coil bending machine for producing a bend in a predetermined loop consisting of one convolution of a continuously wound coil of predetermined given length. The bend is a 180° turn and is repeated a plurality of times at given desired intervals to produce a coil pattern of a given number of sections parallel in their relationship to each other and of desired required lengths. This machine is an improvement and modification of the bending machine disclosed in application, Serial No. 290,776, filed May 29, 1952, by the same inventors, assigned to the same assignee as the subject application, and entitled "Coil Bending Machine for Projection Lamp Filaments."

The coil bending machine of our invention for monoplane projection lamp filaments is provided with a cam shaft driven by a fractional horse

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power motor and a one revolution clutch for moving the cam shaft through a cycle of the bending operation. Downward motion of a hand lever advances a coil bending blade toward a continuous coil positioned against a coil stop and locator, just making contact therewith. During the course of the hand lever's travel it closes a coil preheat micro switch in a coil preheating circuit thus passing preheat current to the coil. At the end of its motion the hand lever trips a clutch release lever, thereby releasing the clutch and starting the cam shaft on its one revolution cycle of operation.

A coil heating switch control cam activates a second micro switch in a main coil heating circuit which continues to supply heating current after the hand lever micro switch opens. The period of time during which this heating current is applied to the coil is varied and controlled by the adjustable control cam which activates it.

Immediately after the coil heating switch cam takes action a coil stop and locator cam moves the coil stop and locator into its "out" position. At the same time a bending blade positioning cam moves the bending blade from its hand lever positioned location, as explained above, (i. e., merely touching the coil for electrical contact) forward into the coil and secures one loop or turn of the coil between the bending blade and a pair of bending chisels, mounted on a pair of hinged elements.

When the electrical circuit has been closed and one turn of the coil has been secured between the bending chisels and the bending blade, a bending chisel operating cam through connecting linkage swings the hinged elements and hence the bending chisels in a circular motion around the axis of a center hinge post to form the desired bend in the coil.

The operating cam and bending blade positioning cam respectively return the bending chisel and the bending blade to their neutral positions. The coil stop and locator cam moves the coil stop and locator to its "in" position. The one revolution clutch arrives at its starting position where it is stopped by the clutch release lever.

According to our invention we have provided an improved mounting for the bending chisel holders. We employ modified hinged elements and a pair of segments, each fastened to the outer surface of said hinged elements to provide the bending chisels with a wider range of angular positioning with respect to the center hinge post. In addition, this mounting provides better support for the bending chisels and more accurate radial

positioning of the chisels themselves with respect to the bending chisel holders.

We also employ improved bending chisels having outwardly tapered flats to provide clearance for the already formed sections of the coil undergoing bending.

In addition we employ a bending chisel operating slide bell crank lever having individual separable arms and hubs connected by an angular segment on one arm by which the angle between the individual arms of the bell crank lever may be varied to change the length of the slide stroke without necessitating a change in the bending chisel operating cam. This longer or shorter length of the slide stroke may swing the bending chisels any desired number of degrees below 180°.

We further employ an improved coil stop and locator having a horizontally located transparent coil guide which holds the coil undergoing bending in a flat horizontal position.

In its general aspect the present invention has as its objective a coil bending machine for monoplane projection lamp filaments.

A specific object of the present invention is an improved means for mountng the bending chisels on the chisel holders to provide better support, and improved angular and radial location of said chisels.

A further object is a bending chisel operating slide bell crank lever having individual arms and hubs and connected by an angular segment on one arm to permit variation of the angular relationship between the bell crank lever arms.

An additional object is an improved coil stop and locator for monoplane filaments having a horizontally located coil stop for holding the coil flat in said locator and permitting greater accuracy in the alignment of said coil.

Other objects of the present invention will become apparent to those skilled in the art to which it appertains as the description thereof proceeds.

In the attached drawings in which like numerals indicate similar parts throughout the several views:

Fig. 1 is an elevational view of a coil bending machine of our invention.

Fig. 2 is a plan view of the coil bending machine of Fig. 1.

Fig. 3 is a fragmentary elevational view of a conventional projection lamp having a monoplane multi-section filament which may be formed by the machine of our invention.

Fig. 4 is a horizontal sectional view of such a projection lamp filament along the line IV—IV of Fig. 3 in the direction of the arrows.

Fig. 5 is a plan view of a coil bending head showing a coil bending blade and a pair of hinged bending chisels at the start of a loop forming cycle and embodying an improved bending chisel mounting and bending chisel of our invention.

Fig. 6 is a vertical sectional view of the coil stop and locator along the line VI—VI of Fig. 5 in the direction of the arrows.

Fig. 7 is a horizontal sectional view of the coil bending head on the line VII—VII of Fig. 5.

Fig. 8 is a horizontal sectional view of the coil bending head on the line VIII—VIII of Fig. 7 in the direction of the arrows showing a continuous coil positioned against the coil stop and locator at the start of the 180° bending operation for forming the first section.

Fig. 9 is a view similar to Fig. 8 showing the completion of the first section bend in the monoplane projection lamp filament.

Fig. 10 is a view similar to Fig. 9 showing the retraction of the bending blade with the now bent coil thereon.

Fig. 11 is a view similar to Fig. 8 showing the once bent coil positioned against the stop and the location of the first section on the bending chisels at the start of the second section bending cycle.

Fig. 12 is a view similar to Fig. 11 showing the location of four formed sections of the coil on the bending chisels at the start of the bending operation for forming the last section.

Fig. 13 is a view similar to Figs. 9 and 12 showing the position of the parts after the formation of the leg mounting portion in the first section of the coil.

Fig. 14 is a view similar to Fig. 13 showing the position of the parts after the formation of the leg mounting portion in the last section of the coil.

Fig. 15 is a fragmentary side elevational view of the improved bell crank lever for the bending chisel operating slide showing the arms thereof in position for a preliminary 180° section forming bend of the coil.

Fig. 16 is a view similar to Fig. 15 showing the arms of the lever in position for a 90° filament mounting leg portion bend for the first and last sections of the coil.

Fig. 17 is a schematic wiring diagram of the coil preheat circuit and coil heating circuit.

Fig. 18 is a diagram of operations of the coil bending machine.

Referring to the drawings, and in particular to Figs. 1 and 2, a coil bending machine for projection lamp filaments is designated by the reference numeral **10**. This machine has a frame **11** comprising a platform **12** and a base **13** integrated by suitable side plates and corner supports. A starting hand lever **14** is mounted on an outer or hand lever shaft **16** which is rotatable in a pair of brackets **17** and **18** depending from the bottom surface of the top mounting plate of the frame **11**.

Handlever mechanism

On this shaft **16** is affixed an adjustable collar **20**, shown in Fig. 2, carrying an arm **22** which engages a stop **24** on the bracket **18**, thereby limiting the rotation of the shaft **16** and the hand lever **14**. Adjacent the bracket **17** an arm **26**, shown particularly in Fig. 1, is secured at one end to the shaft **16** and pivotably connected at its other end to a bending blade slide rod **28** provided with an adjustable slot **30**, and having a microswitch trip arm **32** on its lower end for closing a coil preheat microswitch **34**. As shown in Fig. 17, switch **34** is in series with a variable resistor **35** and one of the bending chisels as hereinafter described. One end of a lever **36** mounted in a suitable bracket **38** carries a pin which slides in the slot **30**. The opposite end of the lever **36** carries a pin which is similarly engaged in a U-shaped slot in the upper end of a clutch release lever **40**.

The other end of the lever **40** is secured to one end of a clutch release shaft **42** which rotates in a suitable bushing in the bracket **38** and another bushing in a similar bracket **44** (Fig. 2). On the other end of the shaft **42** adjacent bracket **44**, is a clutch release lever **46** for releasing a one revolution clutch **47** on a main cam shaft **48**. An arm **49**, (Fig. 2) having a spring between its outer end and the bottom plate of the frame **13**, provides suitable return means for the shaft **42**.

Adjacent the arm **22** on the shaft **16** is a bending blade trip arm **50**, shown in Fig. 1. The outer

end of the arm 50 is engageable with a lower pin 51 extending from a bending blade arm 52 secured at its upper end to a gear segment shaft 54 which is rotatable thereby in suitable bearings on a coil bending head bracket 56. A bending blade gear segment 58, secured to the outer end of the shaft 54, engages a rack 59 which is slidable in a trough 60 (Fig. 2) formed in the upper surface of the coil bending head bracket 56.

It will be understood that downward movement of the hand lever 14 causes forward movement of the slide bracket 58 by means of the connecting linkage just described. Secured on the slide rack 59 by suitable means, such as screws, is a pair of bending blade mounting plates 62 and 64, connected by a right and left hand adjustment screw 66. Adjustably mounted in a lateral slot in the forward end of the mounting block 64 is a bending blade holder 68 which carries thereon the bending blade 70 for movement against and then insertion into a space between two predetermined turns of a continuous coil 71.

Bending blade final positioning mechanism

Adjacent the bending blade trip arm 50, an adjustable bending blade connecting rod 72 is secured to the pin 51 carried on the lower arm of the bending blade arm 52, as shown in Fig. 2. The other end of the connecting rod 72 is pivoted on the upper end of a bending blade cam arm 74, shown most clearly in Fig. 1, which has its lower extremity pivoted in a suitable bearing on a bracket 76 mounted on the base 13 of the frame 11. The cam arm 74 carries a cam roller 78, a suitable distance between the bracket 76 and the connecting rod 72, for engagement with the bending blade final positioning cam as hereinafter explained. Suitable return means for the connecting rod 72 is provided by a spring 80, shown in Fig. 1, extending from the left end portion of the rod 72 to a mounting pin 81 in the platform 12 of the frame 11.

The main cam shaft 48 is mounted on three brackets 84, 85 and 86, shown in Figure 2, on the base 13 of the frame 11 and driven through gears in a gear box 88 by suitable means such as a 1/20 hp. motor (not shown).

Coil stop and locator mechanism

As shown particularly in Fig. 2, a coil stop and locator cam 90 is affixed to the shaft 48 adjacent the bracket 86, for moving a coil stop and locator 92, as hereinafter explained. A locator cam arm 94, shown in Fig. 1 adjacent the cam 90, having its lower end rotatably pivoted to a suitable bracket 96 on the base 13 of the frame 11, carries a cam roller 98 and has its upper end connected to an adjustable locator connecting rod 100. The other end of the rod 100 is pivoted on a lower horizontal locator arm 102 having its other end fixed on a vertical locator shaft 104, which rotates in a bearing bracket 106 mounted on the platform 12. The upper end of the shaft 104 is connected by means of an upper locator arm 107, fixed thereon as shown in Fig. 2, to the coil stop and locator 92 by a vertical pin 93 on the end of the arm 107, secured in an annular groove 108 (Fig. 2) in the end of the locator 92.

The coil stop and locator 92 is slidable in a direction transverse to the bending blade 70 in a suitable bearing mounted in a coil stop and locator bracket 110. A U-shaped horizontal bracket 112 shown in Fig. 2 is provided on the bracket 110 under the locator 92. Bracket 112 has a pair of adjustment screws 113 and 114 extending toward one another from its arm for engagement with a lug depending from a guide 115 carried on the locator 92 adjacent the groove 108 therein. An adjustable stop 116 is provided in the upper portion of the guide 115 (Fig. 1) for limiting forward motion of the locator 92 by engaging the outer surface of the bracket 110. A return spring 119 extends from a pin on the connecting rod 100, near its connection with the arm 94, to a pin 120 depending from the platform 12.

Coil stop and locator

The operating end of the locator 92 (Fig. 6) adjacent the bending blade 70 has an improved transparent plastic coil stop 200, which is secured to the locator 92 by means of a screw 202. The coil stop 200 is provided with a coil stop slot 204 in its forward face for positioning a continuous coil 71 therein, as hereinafter explained. This improved coil stop 200 provides an operator, engaged in positioning a continuous coil thereagainst, with better visibility. The width of the slot 204 accommodates an already formed section and the next section to be formed in the continuous coil 71, thus facilitating the formation of subsequent sections, as hereinafter explained.

Bending blade final positioning cam

Adjacent the coil stop and locator cam 90 on the cam shaft 48, is the bending blade final positioning cam 121 (Fig. 2) which engages the roller 78 on the cam arm 74, as shown in Figure 1.

Bending chisel operating mechanism

Adjacent the cam shaft bracket 85 (Fig. 2) is the bending chisel operating cam 122. An improved bending chisel bell crank lever 208, shown in Figs. 1, 15 and 16, is pivoted on shaft 210 in a bracket 126 on the platform 12 and has a cam roller 128 on its lower arm 211 in engagement with the cam 122. The other arm 212 of lever 210 is bifurcated to leave a slot 130 in its upper end. A block 132 slides in the slot 130 and its movement is limited by adjustment screw 133 carried by a plate 134 bridging the slot 130. The block 132 is connected by a pair of links 136 (Figs. 1 and 2) to a block 138, depending from a bending chisel slide block 140. A center clearance hole or slot 139 shown in Fig. 2, is provided in the slide block 140, through which the upper arm 212 of the bell crank lever 208 moves. A slide block return spring 142 has one end connected to the slide block 140 above the block 138 and its other end connected to a suitable pin projecting from the platform 12. This block 140 is slidably carried by a mounting bracket 144 upstanding from the platform 12.

A pair of bending chisel links 146 and 148, shown in Figs. 1, 2, 5 and 7, are connected by means of a common pivot pin 149 to the forward portion of the slide 140. The forward portions of the links are respectively connected to a pair of improved hinged elements 213 and 214 (Fig. 5) which swing about a center hinge post 154. This post 154 in turn is mounted on a suitable bracket 156 (Fig. 1) on the platform 12. The hinged elements 213 and 214 carry bending chisel mounting segments 216 and 218, respectively, on which are mounted improved bending chisels 220 and 222, respectively, in normally parallel spaced relation to each other for insertion from the opposite direction into the adjacent spaces in the two preselected turns which bound the blade receiving space.

Bell crank lever for bending chisel operating slide

The lower arm 211 of the bell crank lever 208 (Figs. 15 and 16) is provided with a separate hub 224 and an angular segment 226 adjacent said hub. The bifurcated arm 212 in turn has a separate hub on the shaft 210. A removable pin or bolt 228, extending through the arm 212 below the slot 130 can be secured in a plurality of adjustment holes 230 and 232, arranged in an arc near the periphery of the angular segment 226 of the lower arm 211. The holes 230 and 232 are employed respectively for making a 180° section bend as shown in Fig. 15 and for a 90° filament mounting leg bend, as shown in Fig. 16.

It will be understood that when the pin 228 engages the hole 230 in the segment 226, the roller 128 on the end of the lower arm 211 is closer to the bending chisel operating cam 122 than the case where the pin 228 engages the adjustment hole 232, as shown in Fig. 16. Hence, in the showing of Fig. 15 the raised portion of the cam 122 will rotate the upper bifurcated end of the arm 212 of the lever 208 through a larger counterclockwise angle of rotation, the slide block 140 will have a longer stroke, and the chisels 220 and 222 will swing through a larger angle than in the showing of Fig. 16.

These adjustment holes 230 and 232 in the segment 226 are spaced at a predetermined interval so that when the pin 228 engages the hole 230, the improved bending chisels 220 and 222 are moved through an angle sufficient to bend the coil 71 through an angle of 180°. When the connecting pin 228 extends through the adjustment hole 232 in the segment 226 the bending chisels 220 and 222 swing the leg mounting portions of the first and last sections of the coil 71 through an angle of rotation of 90°.

It will be further understood that if it be desired to rotate the bending chisels through any desired angle between 0 and 180° that additional adjustment holes, similar to the holes 230 and 232, may be provided in the segment 226. Thus, any desired swing of the chisels 220 and 222 may be achieved without changing the shape of the bending chisel operating cam 122.

Bending chisel mounting

The upper portion 234 of the hinged elements 213, and 214 (Figs. 5 and 7) preferably have a circular sector horizontal cross section. The upper portion 234 of the hinged element 213 carries a lipped coil positioning guide 235 on the edge adjacent the bending blade 70 for holding the unbent portion of the coil 71 in the horizontal plane of the upper portion 234. A bending chisel mounting plate 236 is secured to the outer periphery of each upper portion 234, of the hinged elements 213 and 214.

Each of these plates 236 has an annular segment portion 238, contoured to fit the periphery of the upper portion 234 of the hinged elements 213 and 214. The segment portions 238 are provided with adjustment slots 240 and are secured to the upper portions 234 of the hinged elements 213 and 214, as by bolts extending through these slots 240. It will be understood that a wide range of desired angular locations of the bending chisels 220 and 222 may be achieved by means of these slots 240.

Each of the bending chisel mounting plates 236 has a rearward extension or chisel holder mounting bracket 242, on which a split collar chisel holder 244 (Fig. 7) is mounted. These chisel holders 244 are held together by suitable bolts and are provided with longitudinal chisel slots for reception therein of the chisels 220 and 222. The rearward portion of each of the bending chisels 220 and 222, carries a combination terminal block and positioning bracket 246.

Each of the combination terminal block and positioning brackets 246 is provided with a series of horizontal holes, namely, a positioning rod hole, a chisel mounting hole and a terminal hole. The upper end of each bracket 246 is bifurcated by a slot extending from the top of the block 246 to the chisel mounting hole. The bifurcated ends of the bracket 246 are secured together by means of a bolt. In turn the bending chisels 220 and 222 and the heating circuit terminal connections are fixed securely in the bending chisel holes and terminal holes by means of a bending chisel mounting bolt 248, and a similar bolt respectively. The bracket 246 carries a headed positioning rod 250 in the positioning rod hole. The forward end of each rod 250 normally rests against a chisel holder 244.

It will be understood that accurate radial positioning of the bending chisels 220 and 222 may be obtained by loosening the bending chisel mounting bolts 248 in the brackets 246, thus permitting the brackets 246 to slide with a desired amount of friction on either or both of the bending chisels 220 and 222. Insertion of a feeler gauge between the forward end of the positioning rod 250 and the chisel holders 244 gives an accurate setting for the desired amount of movement of the bending chisels 220 and 222. After the desired setting is obtained the bending chisel mounting bolt 248 is tightened. The split collar chisel holder 244 is moved backwardly the desired distance against the inner end of the positioning rod 250, thus producing accurate radial positioning of either or both of the bending chisels 220 and 222.

Bending chisel

The improved bending chisels 220 and 222 of our invention are provided with outwardly tapered flats on their operating ends to provide support and clearance to the already bent portions of the coil 71 during the bending of a subsequent section. It will be understood that in monoplane coil bending these already formed sections of the resilient coil 71 are supported on the bending chisel flats and remain in a relatively horizontal plane.

Coil heating switch control mechanism

On the end of the main cam shaft 48 adjacent the cam shaft bracket 84 is a coil heating switch control cam 166 (Fig. 2) which engages a roller 168 on the end of a coil heating switch arm 170, pivoted on a bracket 172. This bracket 172 also supports a heating control micro switch 174 which is suitably connected in series with a variable resistor 175, as shown in Figure 17.

Preheating circuit for coil

The coil preheating circuit (Fig. 17) has one side of the voltage supply, L1, connected to the bending blade 70. The other side of the supply, L2, is connected through the normally open micro switch 34 and the variable resistor 35 to the bending chisel 222. The other bending chisel 220 is tied electrically to the chisel 222 by a suitable line. It will be understood that the downward motion of the hand lever 14 pushes the bending blade 70 into contact with the contin-

uous coil 71, and the coil in turn against the bending chisels 220 and 222, and closes preheat switch 34, thereby completing the circuit.

Main heating circuit for coil

In the main coil heating circuit, as shown in Fig. 17, normally open micro switch 174 and variable resistor 175 in electrical series with each other, are in electrical parallel with the preheat switch 34 and variable resistor 35. The circuit is completed by the closing of heating switch 174 upon operation of the cam 166.

Filament section forming operation

According to our invention, the continuous coil 71 is placed along the guide 235 and under the lip thereof on the upper portion 234 of the hinged element 212, shown in Fig. 8, and moved toward the locator 92, (which is in its "in" position) so that its forward end is sufficiently close to the coil stop slot 204 in the coil stop 200. This insures that the portion selected for bending will be sufficiently large to form a mounting leg portion and a coil section which we call #1.

As the starting hand lever 14 is moved downwardly, the bending blade 70 simultaneously starts its inward or forward movement, as shown in Figure 18, toward coil 71 on the center hinge post 154. It will be understood that as the shaft 16 and the bending blade trip arm 50 rotate counterclockwise, due to the downward movement of the lever 14, the shaft 54 and the gear segment 56 thereon are rotated clockwise by means of the arm 52. This clockwise motion of the segment 56 moves the rack 59 to the right, as viewed in Figs. 1 and 2, in the trough 60, until the bending blade 70 just touches the coil 71, positioned against the chisels 220 and 222.

When the bending blade 70 has completed approximately ½ of its travel, as shown in Fig. 18, the micro switch 34 in the coil preheat circuit is closed by the action of the trip arm 32 on the slide rod 28. The counterclockwise rotation of the shaft 16 and arm 26 thereon causes the slide rod 28, and hence the trip arm 32 thereon, to move diagonally upward, as shown in Figure 1, to close the switch 34, also shown in Fig. 17, and thereby supply preheat current to the coil 71. This switch 34 remains closed until the hand lever 14 is released.

Slightly before the lever 14 and the bending blade 70 reach the end of their respective travels, the clutch release lever 46 on the shaft 42 releases the one revolution clutch 47, and the cam shaft 48, driven by a motor (not shown), with the cams 90, 121, 122 and 166 thereon, start their revolution. The clockwise rotation of shaft 16 and the arm 26 thereon, causing the diagonally upward movement of the slide rod 28, also causes the clockwise rotation of the shaft 42 and the clutch release lever 26 thereon, by means of the connections heretofore described.

As the main cam shaft 48 starts to turn, the main heating micro switch 174 is closed by engagement of a raised portion of the coil heating switch control cam 166 with the roller 168 on contact arm 170. As shown in Figure 17, closing of the switch 174 supplies heating current through the resistor 175 and the bending chisels 220 and 222 to the coil 71.

Further rotation of the main cam shaft 48 and cam 120 thereon, positions the bending blade 70 in its final position, approximately .015" further into the space between the two preselected turns of the coil 71, thereby securely holding one turn of the coil between the bending blade 70 and the two bending chisels 220 and 222, which are now inserted from the opposite direction in the adjacent spaces in the two preselected turns which bound the blade receiving space. A raised portion of the bending blade final positioning cam 121 moves the roller 78, and hence the roller arm 74 and the connecting rod 72, toward the left end of the machine, as shown in Fig. 1. This motion of the rod 72 moves the arm 52 on the shaft 54 and hence rotates clockwise the segment 58 on the other end of shaft 54, to cause the additional required motion of the bending blade 70.

Simultaneously, (Fig. 18) the coil stop and locator cam 90 moves the coil stop and locator 92 from its "in" position to its "out" position. Rotation of a raised portion of the cam 90 against the roller 98 moves the roller arm 94 and the connecting rod 100 horizontally to the right, as shown in Figs. 1 and 2. This motion rotates the lower arm 102 on the bottom of the shaft 104, and hence the shaft 104 and the upper arm 108 on the upper portion of the shaft 104 with its pin 93 on the outer end, clockwise in a horizontal plane. This pin 93 in the groove 108 on the rearward portion of the coil stop and locator 92, moves the locator 92 away from the post 154 or to its "out" position.

Further rotation of the shaft 48 causes the bending chisels 220 and 222 to swing on the hinged elements 212 and 213, respectively, about the center hinge post 154, as shown in Fig 9, and bend the coil 71 about its preselected turn into parallel sections aligned along the bending blade 70. This action of the chisels is accomplished by operation of the bending chisel operating cam 122 through its connecting linkage. A raised portion of the cam 122 moves the roller 128 on the lower arm 211 of improved bell crank lever 208 upwardly, and hence the block 132 in the slot 130 in the upper arm 212 of the crank 208 towards the center hinged post 154. This motion is transmitted to the bending chisel slide block 140 by means of the links 136 affixed to the block 138 on slide block 140. The links 146 and 148 on slide block 140 cause the bending chisels 220 and 222 to swing about the post 154.

Simultaneously, as shown in Fig. 18, with the completion of the swinging of the bending chisels 220 and 222, the main heating switch 174 is opened by means of the coil heating switch control cam 166. Further rotation of the shaft 48 moves the roller 128 on the lower arm 211 of the crank 208 off the raised portion of cam 122 thereby moving the slide block 140 and the bending chisels 213 and 214 connected thereto back to their starting position, with the aid of the return spring 142, as shown in Fig. 1.

Before the bending chisels complete their return to the starting or neutral position, roller 78 on arm 74 runs off the raised portion of the bending blade final positioning cam 121 thus retracting the bending blade 70 and the now bent coil 71 thereon (Fig. 10) by means of the connecting mechanism explained above and the return spring 80 (Fig. 1) on the end of rod 72.

A short time after the return of the bending chisels 220 and 222 to their starting position, the roller 98 rolls off the raised portion of the coil stop and locator cam 90 and the coil stop and locator 92 is returned to its "in" position, as shown in Fig. 11, by means of the connecting mechanism explained above and the return spring 119 (Fig. 1) on the connecting rod 100.

Just before the end of the one revolution of the

main cam shaft 48, which requires a few seconds, the clutch release lever 46 engages the one-revolution clutch 47 and stops further rotation of the shaft 48 and the cams 90, 121, 122 and 166 thereon.

The now bent coil 71 is removed from the bending blade 70 and inserted by hand into the coil stop slot 204 of the coil stop 200 (Fig. 11) on the inner end of the coil stop and locator 92.

It will be understood that the unbent portion of the coil 71 is held flat on the upper portions 234 of the hinged elements 212 and 213 by the lipped positioning guide 235 and that the bent first section of the coil 71, resting on the tapered flats of the bending chisels 220 and 222 is also in a relatively horizontal plane.

It will be understood that this slot 204 is positioned so that the distance from the inner face of the slot to the center of the hinge post 154, the point of contact of the bending blade 70 with the coil 71, is the desired distance or the desired number of turns between bends yet to be formed in the next section of the coil 71. Considered another way, this above mentioned position of the slot 204 in locator 92 determines the length of the five remaining sections of a filament 252 (shown in Figs. 3 and 4) to be formed from the coil 71 for a projection lamp 254. Further the improved transparent coil stop 200 provides better operator visibility and, hence a more uniform light source can be obtained.

As the cycle is repeated and successive bends or sections of the filament 252 are formed in the coil 71 by the method described above, the coil 71 is positioned in the slot 204 at the start of each succeeding cycle. As shown in Figure 12, the already formed five sections are positioned on the tapered flats of the bending chisels 220 and 222.

Filament leg forming operation

After the last section of the coil 71 has been formed, the maintenance man removes the pin 228 from the 180° bending hole 230 (Fig. 15) in the segment 226 of the lower arm 211 of the improved bell crank lever 208 for the bending chisel operating slide 140. This pin 228 is then inserted through the upper arm 212 and into the 90° bend hole 232 in the segment 226.

As explained before this simple operation moves the roller 128 upwardly away from the bending chisel operating cam 122 (Fig. 16) and achieves a change over to the desired 90° filament mounting leg bend without disturbing or changing cam 122.

As shown in (Fig. 13) the first and second sections of the coil 71 are positioned in the coil stop slot 204 of the coil stop 200. With the new arrangement of the improved bell crank lever 208, the bending chisel 220 and 222 are swung through the predetermined angle, by the means described above, to form a filament mounting leg portion which is perpendicular to the first section of the coil 71. In like manner, as shown in Fig. 14, the fifth and last sections of the coil 71 are positioned in the coil stop slot 204 and a filament mounting leg portion is likewise formed in the last section of the continuous coil 71 thus forming the filament 252.

Although a preferred embodiment of our invention has been described, it will be understood that modifications may be made within the spirit and scope of the invention.

We claim:

1. A machine for bending a continuous coil into a monoplane multi-section projection lamp filament having a predetermined number of turns between sections comprising; a frame, a bending blade mounted on said frame for movement against and then insertion into a space between two preselected turns of said coil, a pair of swingable bending chisels mounted on said frame in normally relatively parallel spaced relation opposite said bending blade for insertion from the opposite direction into the adjacent spaces in the preselected turns which bound the blade receiving space, a coil stop and locator mounted on said frame transverse to said blade and said bending chisels for determining the preselected turns, a main cam shaft mounted on said frame, a one revolution clutch, a coil stop and locator cam, a bending blade final positioning cam, and a bending chisel operating cam on said main shaft, means for moving said blade into contact with said coil and for releasing said one revolution clutch, means for transmitting sliding motion to said bending blade from said bending blade final positioning cam, a bending chisel operating mechanism for transmitting rotary motion to said bending chisels about a common axis from said bending chisel operating cam comprising; a bell crank lever having a separable lower arm provided with an angular segment adjacent its hub and carrying means thereon for engagement with said bending chisel operating cam, a separable bifurcated upper arm and means for joining said arms in any desired angular relationship therebetween, a bending chisel slide block connected to said bifurcated upper arm, and means for transforming the sliding motion of said block into rotary motion of said bending chisels, means for transmitting "in" and "out" motion to said coil stop and locator from said coil stop and locator cam, and means for rotating said cam shaft.

2. A machine for bending a continuous coil into a monoplane multi-section projection lamp filament having a predetermined number of turns between sections comprising; a frame, a bending blade mounted on said frame for movement against and then insertion into a space between two preselected turns of said coil, a pair of hinged elements mounted on said frame, each element having a horizontal upper portion, a lipped coil positioning guide on one of said upper portions of said elements for holding the unbent portion of said continuous coil in a horizontal plane, a bending chisel mounting plate secured to the periphery of each of said upper portions of said hinged elements and comprising a segment provided with means for securing said mounting plate in any desired angular alignment and a chisel holder mounting bracket, a chisel holder on said bracket, a radially movable bending chisel secured in said chisel holder, a combination terminal block and positioning bracket on said chisel and a positioning rod on said combination block and bracket for radially adjusting said bending chisel, a coil stop and locator mounted on said frame transverse to said blade and said bending chisels for determining the preselected turns, a main cam shaft mounted on said frame, a one revolution clutch, a coil stop and locator cam, a bending blade final positioning cam, and a bending chisel operating cam on said main shaft, means for moving said blade into contact with said coil and for releasing said one revolution clutch, means for transmitting sliding motion to said bending blade from said bending blade final positioning cam, a bending chisel operating mechanism for transmitting

rotary motion to said bending chisels about a common axis from said bending chisel operating cam, means for transmitting "in" and "out" motion to said coil stop and locator from said coil stop and locator cam, and means for rotating said cam shaft.

3. A machine for bending a continuous coil into a monoplane multi-section projection lamp filament having a predetermined number of turns between sections comprising: a frame, a bending blade mounted on said frame for movement against and then insertion into a space between two preselected turns of said coil, a pair of hinged elements mounted on said frame, each element having a horizontal upper portion, a lipped coil positioning guide on one of said upper portions of said elements for holding the unbent portion of said continuous coil in a horizontal plane, a bending chisel mounting plate secured to the periphery of each of said upper portions of said hinged elements and comprising a segment provided with means for securing said mounting plate in any desired angular alignment and a chisel holder mounting bracket, a chisel holder on said bracket, a radially movable bending chisel secured in said chisel holder, a combination terminal block and positioning bracket on said chisel and a positioning rod on said combination block and bracket for radially adjusting said bending chisel, each of said bending chisels having an outwardly tapered flat on its operating end for supporting and maintaining the already bent sections of said continuous coil in a relatively horizontal plane, a coil stop and locator mounted on said frame transverse to said blade and said bending chisels for determining the preselected turns, a main cam shaft mounted on said frame, a one revolution clutch, a coil stop and locator cam, a bending blade final positioning cam, and a bending chisel operating cam on said main shaft, means for moving said blade into contact with said coil and for releasing said one revolution clutch, means for transmitting sliding motion to said bending blade from said bending blade final positioning cam, a bending chisel operating mechanism for transmitting rotary motion to said bending chisels about a common axis from said bending chisel operating cam, means for transmitting "in" and "out" motion to said coil stop and locator from said coil stop and locator cam and means for rotating said cam shaft.

4. A machine for bending a continuous coil into a monoplane multi-section projection lamp filament having a predetermined number of turns between sections comprising; a frame, a bending blade mounted on said frame for movement against and then insertion into a space between two preselected turns of said coil, a pair of swingable bending chisels mounted on said frame in normally relatively parallel spaced relation opposite said bending blade for insertion from the opposite direction into the adjacent spaces in the preselected turns which bound the blade receiving space, a coil stop and locator mounted on said frame transverse to said blade and said bending chisels for determining the preselected turns and having a transparent coil stop provided with a coil stop slot in its operating end for positioning therein a formed section and an adjacent section to be formed of said continuous coil, a main cam shaft mounted on said frame, a one revolution clutch, a coil stop and locator cam, a bending blade final positioning cam, and a bending chisel operating cam on said main shaft, means for moving said blade into contact with said coil and for releasing said one revolution clutch, means for transmitting sliding motion to said bending blade from said bending blade final positioning cam, a bending chisel operating mechanism for transmitting rotary motion to said bending chisels about a common axis from said bending chisel operating cam, means for transmitting "in" and "out" motion to said coil stop and locator from said coil stop and locator cam and means for rotating said cam shaft.

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