Jan. 3, 1928. 1,655,279

M. E. McGOWAN

MOUNT MAKING MACHINE

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Fig. 1.

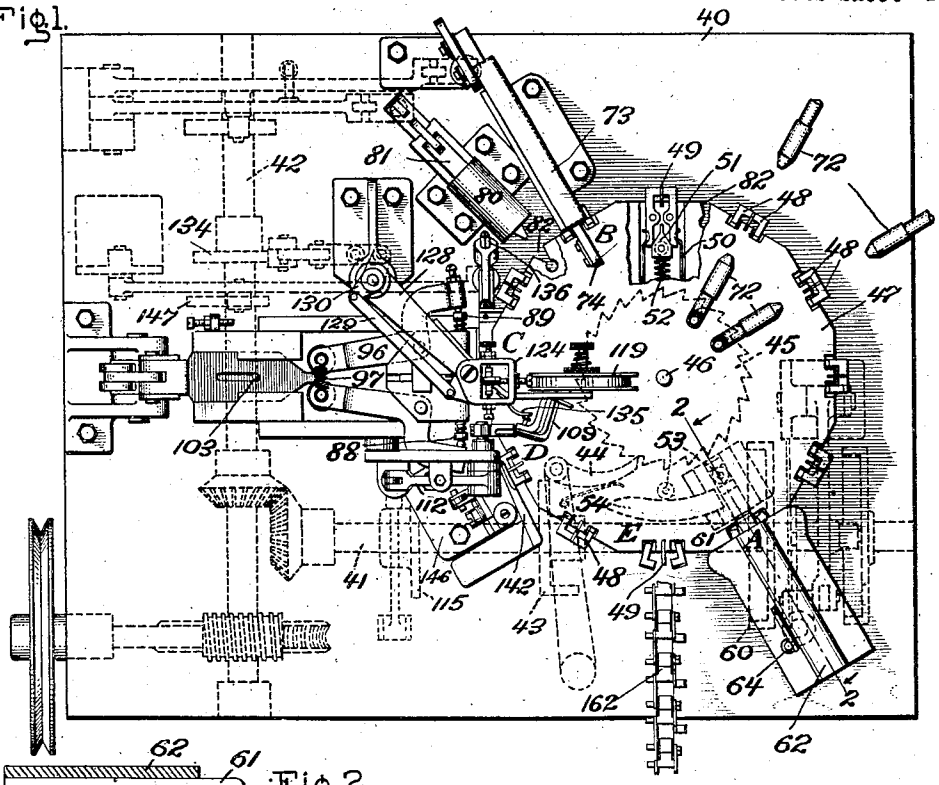


Fig. 2.

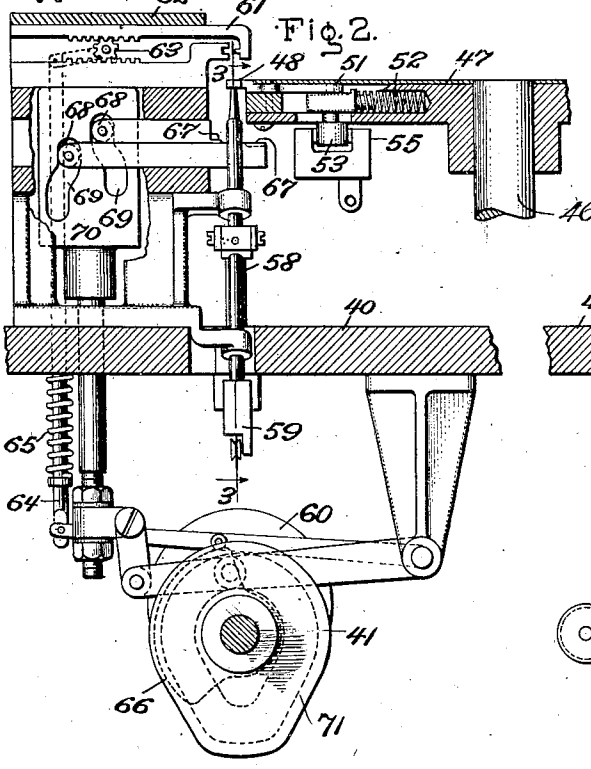
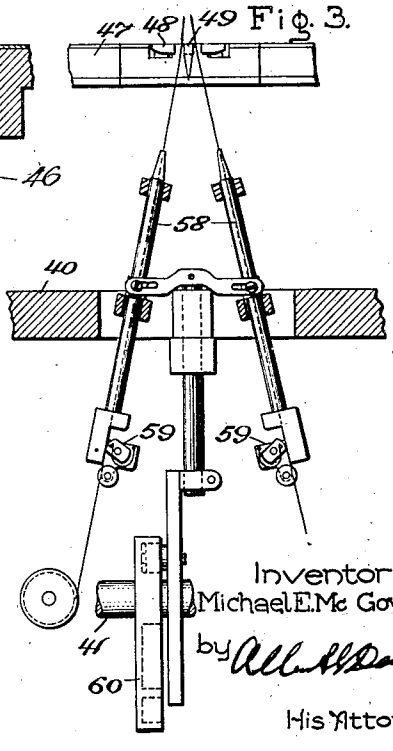


Fig. 3.



Inventor:
Michael E. McGowan
by Albert G. Davis
His Attorney

Jan. 3, 1928. 1,655,279

M. E. McGOWAN

MOUNT MAKING MACHINE

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Fig. 13.

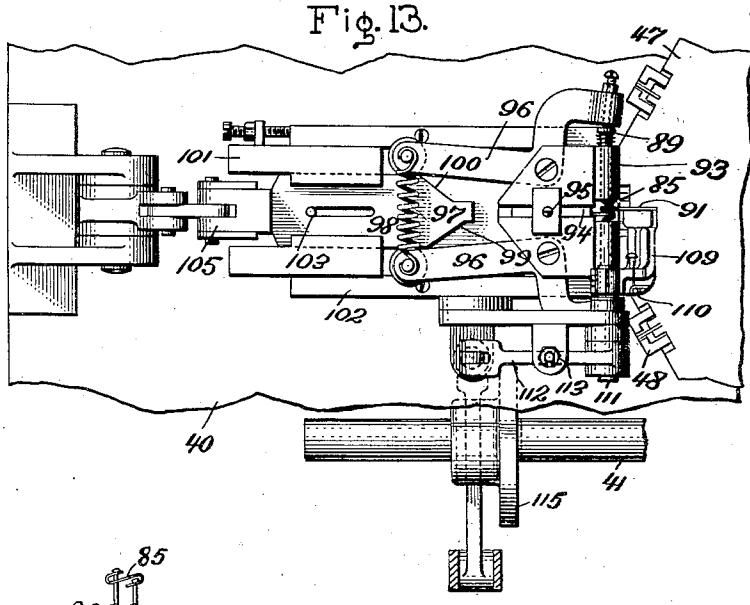


Fig. 4.

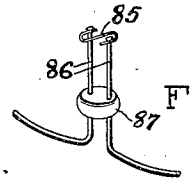


Fig. 5.

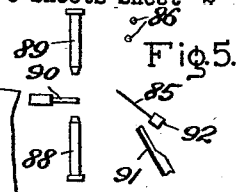


Fig. 6.

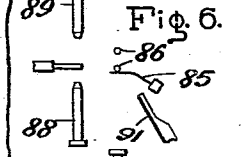


Fig. 7.

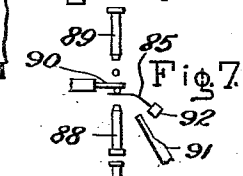


Fig. 8.

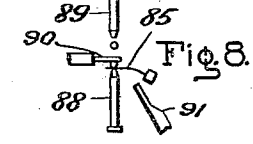


Fig. 9.

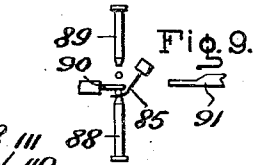


Fig. 14.

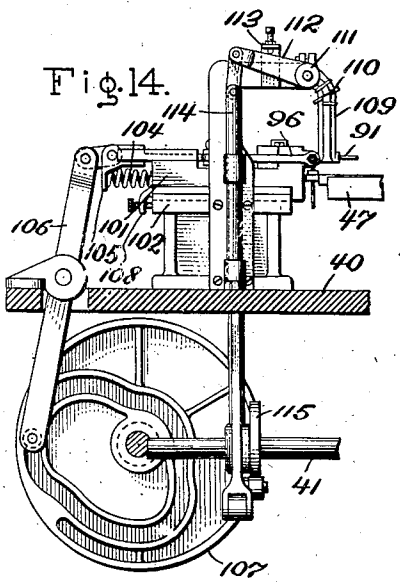


Fig. 15.

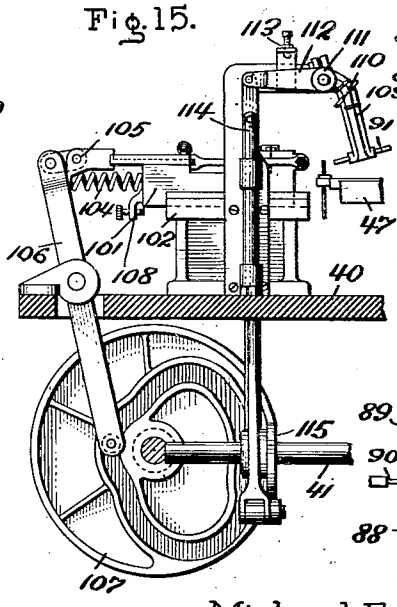


Fig. 10.

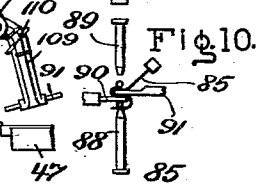


Fig. 11.

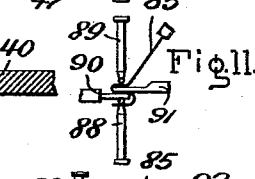
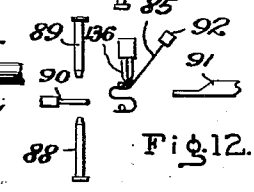


Fig. 12.



Inventor:
Michael E. McGowan,
by Albert G. Davis
His Attorney.

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Fig. 16.

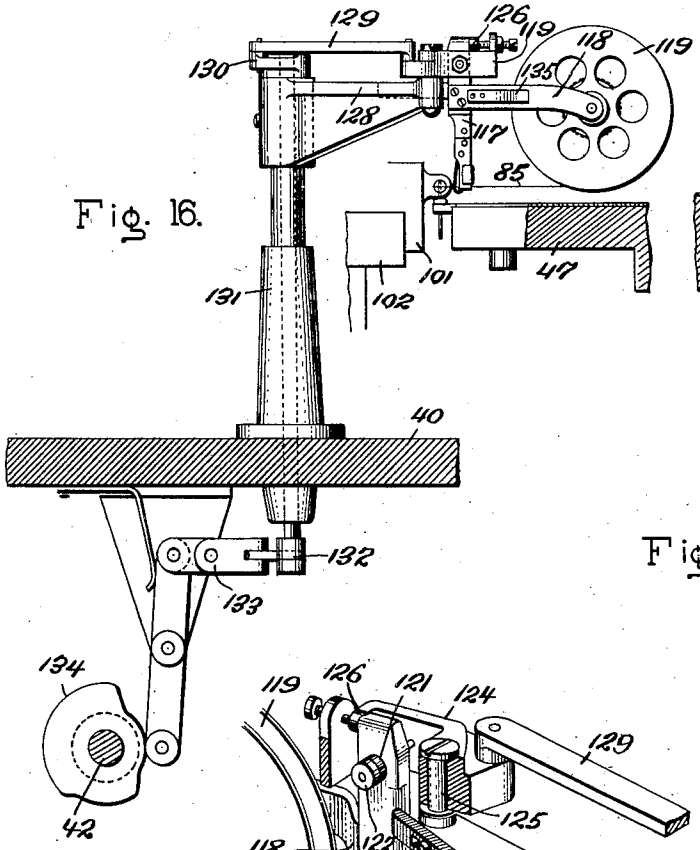


Fig. 20.

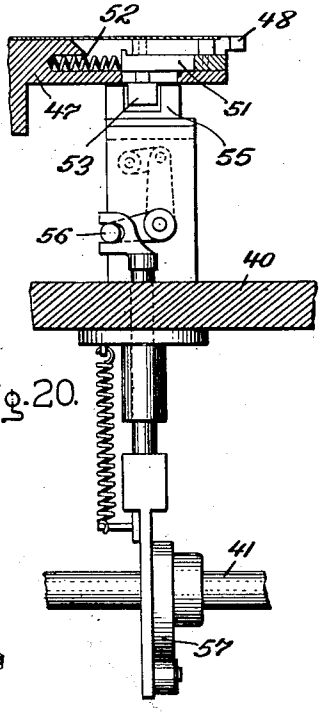


Fig. 17.

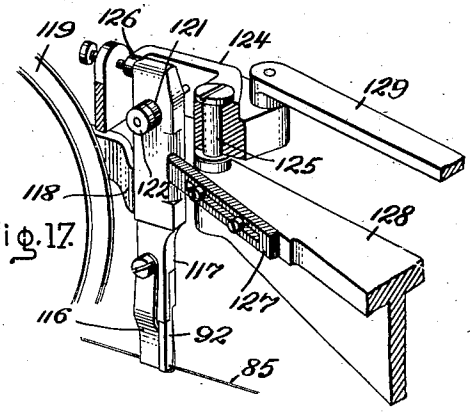


Fig. 18.

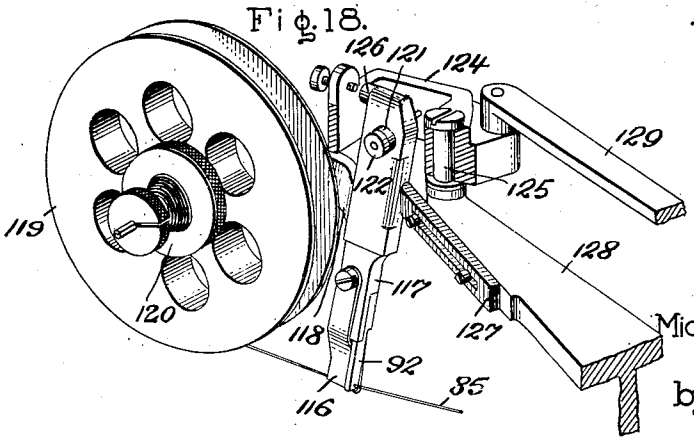
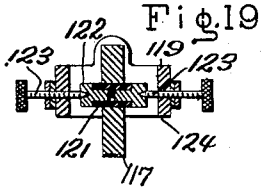


Fig. 19.



Inventor:
Michael E. McGowan,
by Albert Davis
His Attorney.

Jan. 3, 1928. 1,655,279

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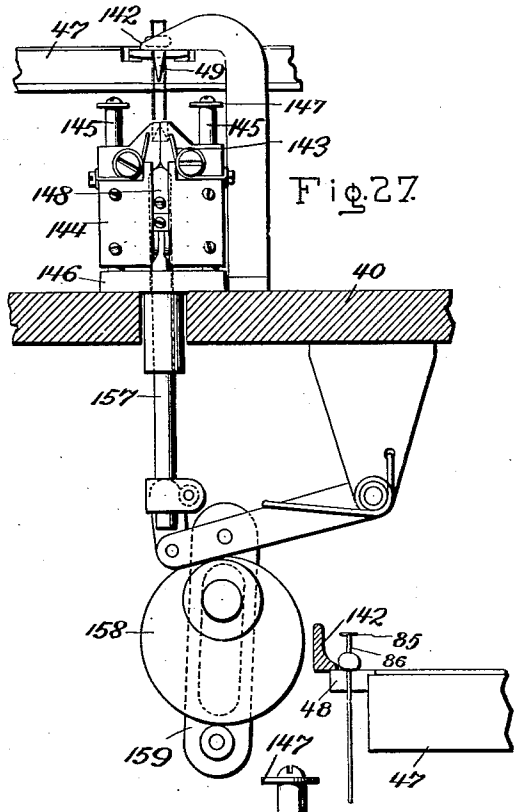

Fig. 27.

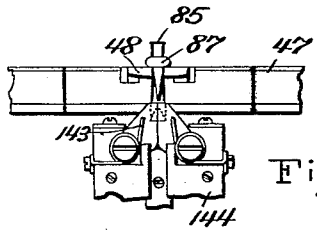

Fig. 29.

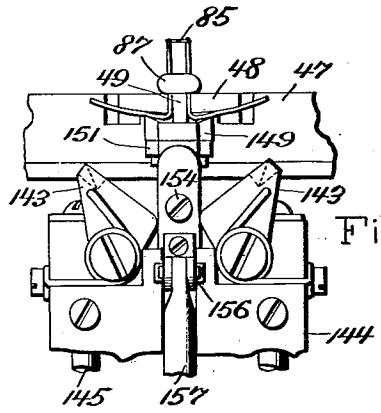

Fig. 30.

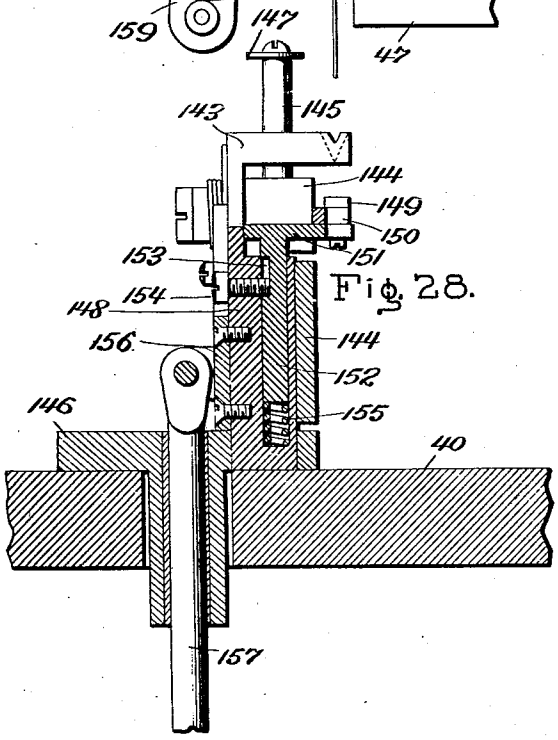

Fig. 28.

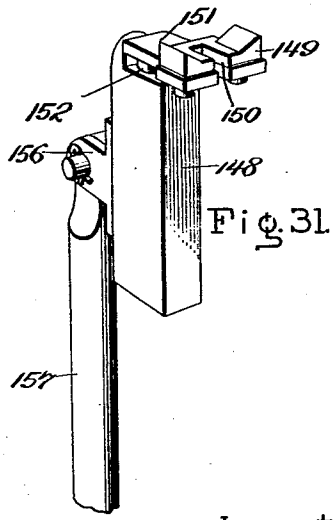

Fig. 31.

Inventor:
Michael E. McGowan,
by Albert G. Davis
His Attorney.

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Fig. 21.

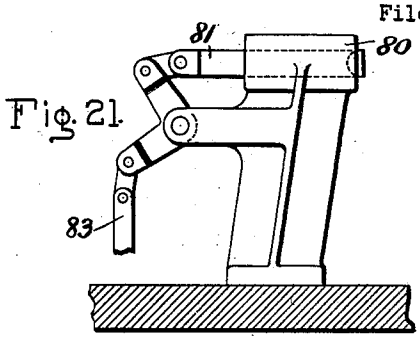
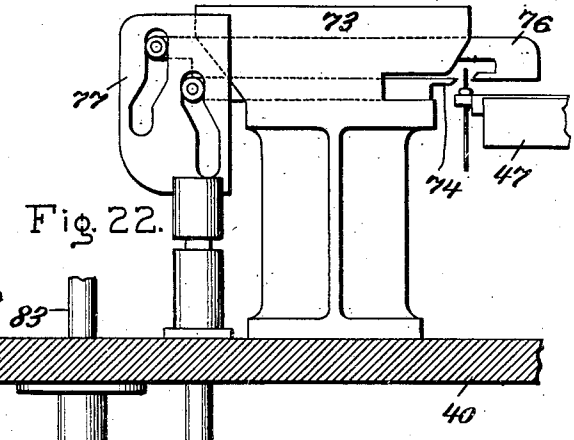


Fig. 22.



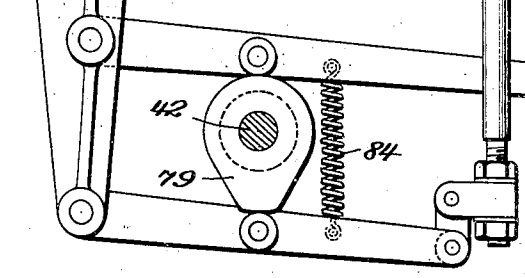
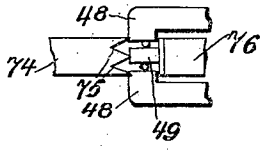


Fig. 23.



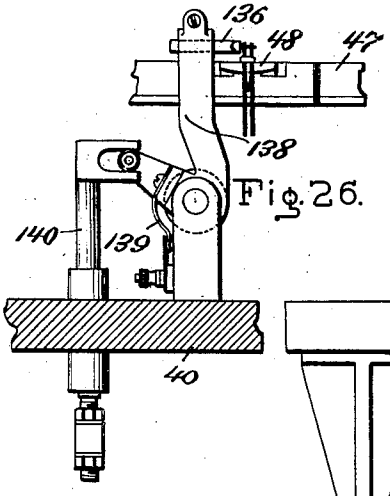


Fig. 26.

Fig. 24.

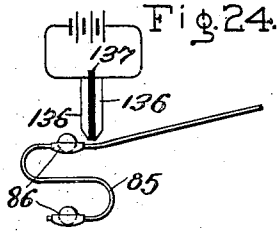
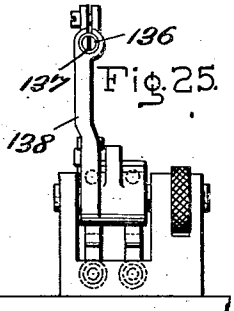
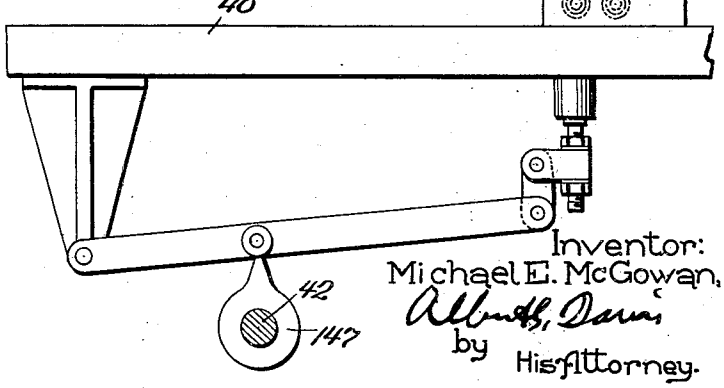


Fig. 25.





Inventor:
Michael E. McGowan,
by Albert G. Davis
His Attorney.

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Fig. 32.

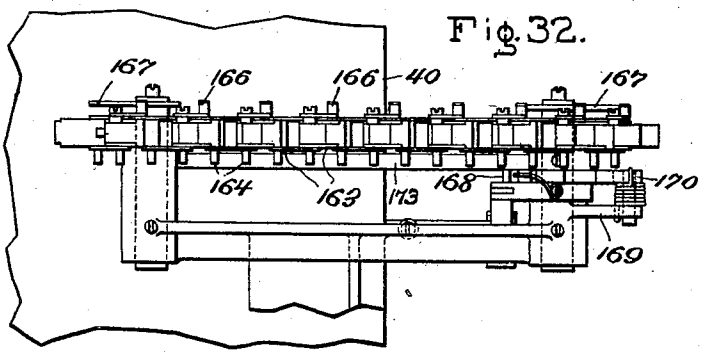

Fig. 33.

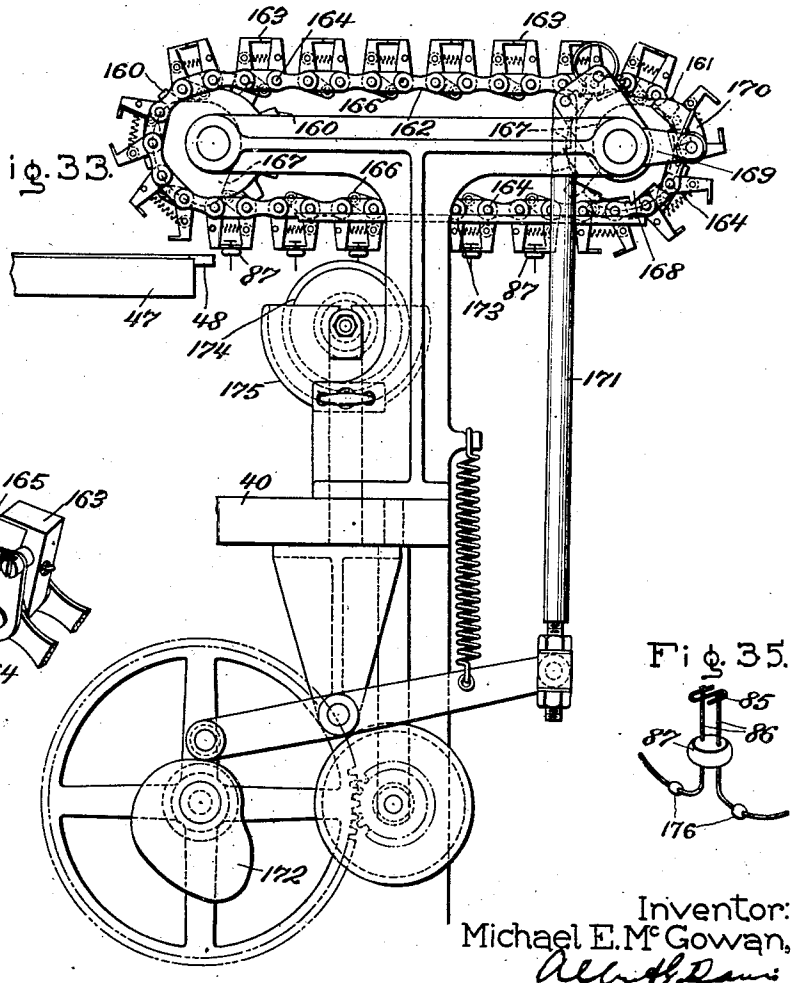

Fig. 34.

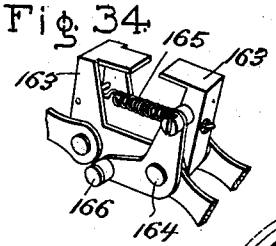

Fig. 35.

Inventor:
Michael E. McGowan,
by His Attorney.

Patented Jan. 3, 1928. 1,655,279

UNITED STATES PATENT OFFICE.

MICHAEL E. McGOWAN, OF NEWARK, NEW JERSEY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MOUNT-MAKING MACHINE.

Application filed November 25, 1921. Serial No. 517,620.

My invention relates to the manufacture of incandescent lamp mounts of the type comprising two parallel lead wires imbedded in a glass bead and supporting a short filament to which these leads also supply the current. This type of mount is used extensively in the manufacture of flashlight lamps designed to operate on low voltages, such as two to four volts. Owing to the very short length of filament, these mounts must be made with very considerable accuracy as to the length of filament included in circuit between the lead wires, and heretofore it has been necessary to have these mounts made by comparatively skilled labor in order to obtain lamps made accurately enough to be of the desired uniformity in candle power and voltage.

One object of my invention is to provide a machine for performing automatically those operations of mount making which require great accuracy and which heretofore could be performed successfully only by skilled operators.

Another object of my invention is to provide a machine by means of which an unskilled operator is able to make mounts which are much more accurately made and more uniform than similar mounts as heretofore made even by the skilled operators ordinarily available in a lamp factory.

A further object is to provide a simple and efficient mount making machine in which the operation of securing the filament to the leads with the proper length of filament in circuit between them and imparting the proper shape to the filament are all performed automatically and with a degree of accuracy and uniformity not obtainable by hand workers under ordinary factory conditions, and not obtainable at all except by very highly skilled operators.

Still another object is to provide a mount making machine which, while automatically holding the lead wires parallel and at the proper distance apart, will take from a long wire or filament, wound on a spool a short length of wire sufficient for a filament, attach it to the leading-in wires, shape the filament, and cut it off from the long wire and thereby free the finished mount, and will also, if desired, automatically deliver the finished mount ready for use in lamp making.

Other objects and advantages of my invention will appear from the description of the particular embodiment thereof which is described in the following specification and of which the novel features are pointed out with greater particularity in the annexed claims, although in its broader aspects my invention is capable of embodiment in numerous forms different from that herein described, and various of the elements illustrated may be changed and modified without departing from my invention.

My invention will best be understood in connection with the accompanying drawing, in which Figure 1 is a plan view, with certain parts broken away, of a machine embodying my invention; Figure 2 is a sectional view along the line 2—2 of Figure 1 showing with certain parts in section, a holder for the leading-in wires, the automatic mechanism for feeding the leading-in wires into place, and parts of other associated mechanism; Figure 3 is a sectional view along the line 3—3 of Figure 2, with some parts omitted and showing the holder for the leads and parts of the wire feeding mechanism in elevation; Figure 4 is a view in perspective of the finished mount made by the machine. Figures 5, 6, 7, 8, 9, 10, 11 and 12 are diagrammatic and fragmentary views of certain parts of the mechanism to illustrate the sequence of operation in feeding the filament into place, attaching it to the lead wires, shaping it, and cutting it off from the spool of filament wire with the end ready to be secured to a lead wire of the next mount; Figure 13 is a plan view of the filament mounting mechanism with the filament wire feeding mechanism omitted for clearness of illustration; Figure 14 is a side view of the mechanism shown in Figure 13. Figure 15 is a side view of the same mechanism shown in Figure 12, but with the parts in a different position. Figure 16 is a side elevation of the filament feeding mechanism with a part of the mount carrying table and one of the pinching jaws of Figure 13 shown to illustrate the relations of the parts; Figure 17 is a view in perspective of part of the filament feeding mechanism in its forward position corresponding to Figure 16; Figure 18 is a perspective view of part of the filament feeding mechanism in its retracted position, corresponding to Figure 12; Figure 19 is a sectional view through the holding frame best shown in Figures 17 and 18, along the pivot of the wire feeding

arm to show how the arm is insulated from the frame; Figure 20 is a side elevation partly in section of the mechanism for actuating the holding jaws which hold the leads of the mount during the mount making operations; Figure 21 is a side view of the indexing or locating pin which accurately positions and firmly holds the rotatable table so that each mount will be in proper relation to the mechanism which operates on it; Figure 22 is a side view of the spacing and cutting mechanism which spaces the ends of the lead wires the proper distance apart and simultaneously cuts them to the proper length, and also positions them at the proper distance from the center of the rotating table; Figure 23 is a plan view looking down upon the spacing and cutting blades with the holders of the blades omitted to show more clearly the relation of the blades to the leading-in wires and the holder in which they are gripped; Figure 24 is a diagram illustrating the cutter for electrically cutting the filament wire. Figure 25 is a front view of the cutter mounted on a swinging arm and showing the actuating mechanism for the cutter; Figure 26 is a side view of the cutter shown in Figure 25 and illustrating its relation to the mount while cutting the filament wire; Figure 27 is an elevation of the mechanism for spreading and shaping the lower ends of the leading-in wires; Figure 28 is a longitudinal view, partly in section of the upper part of the mechanism shown in Figure 27; Figure 29 is an elevation of the spreading fingers of the mechanism shown in Figure 27 at the end of their upward travel when they are between the leading-in wires and are on the point of spreading them apart; Figure 30 is an elevation of the mechanism shown in Figure 29 in a different position where the spreading fingers have finished their spreading movement and the shaping die is imparting the final shape to the leading-in wires; Figure 31 is a perspective view of the shaping die and the sliding block which carries it; Figure 32 is a plan view of a conveyor type of automatic delivery mechanism which I have found advantageous; Figure 33 is a side elevation of the mechanism shown in Figure 32; Figure 34 is a view in perspective of a part of the conveyor chain shown in Figure 31, and Figure 35 is a perspective view of the finished mount delivered by the complete machine.

In the particular form of machine which I have illustrated in the drawings as one embodiment of my invention, the various parts are mounted on a base 40 conveniently made in the form of a heavy table. The driving mechanism is mounted underneath the top of the base 40 and comprises two driving shafts 41 and 42 set at right angles to each other and geared together to operate at the same speed. For imparting an intermittent or step by step movement to a movable carrier for the mounts, the driving shaft 41 carries a cam 43 which at each revolution moves the carrier one-twelfth of its travel by swinging a pivoted arm carrying a pawl 44 which cooperates with a ratchet wheel 45 secured to the lower end of a vertical shaft 46. On the upper end of this vertical shaft 46, which extends through the top of the base 40, is a rotatable carrier or table 47 which carries a mount holder through a number of positions in succession and to which an intermittent or step by step movement is imparted by the mechanism just described, all of which is underneath the top of the base 40.

By means of a travelling carrier such as the rotatable table 47, each mount during its manufacture is brought into operative relation to different mechanisms in succession and is held there stationary for a short time while each mechanism automatically performs some operation on the mount. In the particular machine illustrated, the driving mechanism is so designed that each mount holder stops in twelve different positions during one complete rotation of the table. This number of positions is a convenient one, but a greater or less number can be used, if desired.

The two leads or lead wires of the mount are held in place and substantially parallel during the various operations of making the mount by means of a bodily movable lead wire head or holder mounted on the table 47. In this particular machine twelve holding heads are secured to the rotating table 47 to project radially therefrom, each head consisting of a pair of movable projecting holding jaws 48 which are pivoted near the middle and grip opposite sides of a separator 49 rigidly secured to the edge of the table to project radially from it. The holding jaws are as best shown in Figure 1 normally held open by leaf springs 50, and are positively closed by a spring actuated closing means such as a wedge 51 which is forced by a coil spring 52 into closing position between the ends of the holding jaws to close them upon the separator 49. The wedge 51 is pulled back to permit the holding jaws to open under the influence of the springs 50 by some suitable actuating mechanism which as shown in Figures 2 and 20, engages a pin 53 secured to the wedge 51 to project below the lower surface of the rotating table 47. At the discharge position where the finished mount is to be released, the wedge 51 is pulled back and the jaws are automatically opened because the travel of the table 47 causes the pin 53 to ride along on a stationary cam 54 mounted underneath the rotatable table 47, and shown in dotted lines in Figure 1. This cam holds the wedge 51

back and the jaws open at the discharge position, and keeps them open until the holding head arrives at the next position and is at station A, Figure 1, where the control of the wedge 51 and of the holding jaws is transferred from the stationary cam 54 to an automatically actuated jaw controlling mechanism which controls the jaws as long as the holder head is at station A. This jaw controlling mechanism is best shown in Figure 20, and comprises a sliding block 55 having a slot to receive the pin 53 as the table 47 brings the holding head into position A. This block is moved radially of the rotating table by link work 56 actuated from a cam 57 on the driving shaft 41. The shape and timing of the cam 57 is such that the block 55 is moved toward the center of the table into the position shown in Figure 20, where the pin 53 will enter the slot in the block 55 as rotation of the table 47 moves the pin 53 off the end of the stationary cam 54. The rotatable table 47 then stops, with the holding head at station A and with the holding jaws open because the block 55 is in its retracted position shown in Figure 20. While at station A the holding jaws are under the control of the jaw controlling mechanism, which may be actuated to move the block 55 forward and thereby open the jaws as required.

The leading-in wires from which the leads of the mounts are made are automatically placed side by side in the holder head at station A by some suitable wire feeding mechanism, such as that illustrated in Figures 2 and 3. At this station the jaw controlling mechanism holds back the wedge 51 and the holding jaws are open. The two leading-in wires, preferably of great length and wound on spools, are fed from the spools in such a way that their ends are positioned in the holding head on opposite sides of the separator and between it and the holding jaws. These wires are fed automatically by vertically movable feed tubes 58 preferably set to form an acute angle with each other, as best shown in Figure 3, and provided with one way clutches 59 of such a character that as the tubes rise the clutches grip the leading-in wires and carry them along with the tube to a position where their ends are in the holding head and are seized and held while the tubes move downward along the leading-in wires and the clutches slip along the wires. The feed tubes 58 of the wire feeding mechanism are actuated by a cam 60 on the driving shaft 41. The parts are so timed that while the table 47 is stationary and the holding jaws at station A are held open, the feed tubes 58 are lifted until the upper ends of the leading-in wires which project from the tubes, pass on opposite sides of the separator and between it and the holding jaws as shown in Figure 3. The holding jaws may be closed on the wires at the end of this movement, but as indicated in Figure 2, I prefer to grip the upper ends of the leading-in wires between gripping jaws 61 slidably mounted in a housing 62 and provided with rack teeth which engage a pinion 63 actuated by a crank and a push rod 64. These gripping jaws are resiliently closed to grip the leading-in wires by some suitable means, such as a spring 65, and are positively opened by a cam 66 so shaped as to permit the gripping jaws to be closed by the spring at the proper time. The cam 66 is so set on the drive shaft 41 that after the feed tubes 58 have been raised to the position shown in Figure 2, and while the feed tubes are stationary in their uppermost position, the gripping jaws 61 are closed by the spring 65 to seize the projecting ends of the leading-in wires, whereupon the feed tubes fall back to their initial position, shown in Figure 3, while the wires are held by their upper ends in the gripping jaws. Then the holder jaws 48 close and firmly clamp the wires to the separator 49, and hold them side by side.

The leading-in wires while held by the holding jaws 48, are then cut to the proper length for leads by an automatic shear or cutting mechanism which is placed at station A and comprises cooperating sliding cutter blades 67 actuated to cut the leading-in wires above the ends of the feed tubes 58. I prefer to actuate these sliding cutter blades by providing them with rollers 68 which enter oppositely inclined slots 69 in a vertically movable cam 70 slidably mounted in the housing 62. As the cam rises the rollers 68 are pushed apart due to the inclination of the slots 69, and consequently the edges of the cutting blades 67 are brought together. As the sliding cam 70 is lowered the rollers 68 are pulled toward each other and the cutting jaws are opened. This sliding cam 70 is actuated through a push rod driven by a box cam 71 on the driving shaft 41.

The leads are now of proper length and are held side by side in the holder head at position A because firmly clamped against the separator 49 which holds them at about the proper distance apart. Their upper tips are slightly inclined toward each other due to the fact that they were so inclined when they were seized by the gripping jaws 61, and this slight inclination facilitates the placing of a ring of glass over the two leads by the operator while the holder head is moving through the next two positions. This glass ring is of a size to fit easily over the two leads in the holder head and is conveniently formed by cutting short sections from a glass tube. These sections or rings of glass are set down over the two leads and are of a height which is only a fraction of

the length of lead projecting above the holder head. The glass ring is placed over the two leads by the operator, and as the holding head is carried along by the step by step movement of the table 47 the glass ring passes between two pairs of burners 72, the first pair set to give the ring a preliminary heating, and the second pair set to melt the ring into a glass bead which embeds the middle portion of the leads and holds the leads at approximately the proper distance apart.

The next operation is to space the upwardly projecting ends of the lead wires a definite distance apart, position them radially at a definite distance from the center of the table 47, and cut them to the proper length. These operations are automatically performed at station B by an automatic spacing and cutting mechanism of which a desirable form is illustrated more in detail in Figures 22 and 23. This spacing and cutting mechanism comprises a stationary housing 73 which contains a slidable spacing blade 74, having as shown in Figure 23 two notches 75 for engaging and spacing the ends of the leads, and which also contains a cooperating slidable cutting blade 76 to form with the spacing blade 74 a shear for cutting the leads. The blades are actuated by a sliding double slotted cam 77 like that which actuates the cutter blades 67, but with the upper and lower ends of its slots parallel for a short distance so that the first and last parts of the upward and downward movements of the cam 77 are idle so far as actuating the spacing and cutting blades is concerned. This sliding cam is actuated through a push rod 78 by a cam 79 on the driving shaft 42. The parts are so timed that while a holder head is stationary at station B the spacing blade 74 moves toward the leads in the holder head until its middle point is between the two leads, and above the glass bead which embeds them, and the bottoms of the two notches 75 are at the proper distance radially from the center of the table 47. At the same time the cooperating blade 76 also moves toward the leads, first pushing them into the notches 75 until they are seated at the bottoms of the notches, thereby locating the leads at a definite distance from the center of the table 47 and also spacing them a definite distance apart, and finally shearing off any surplus length of lead which projects above the spacing blade. In some cases it may be desirable to so time the mechanism that the operations just described are performed while the glass bead of the mount is in a plastic condition.

To make sure that in each position of the table 47 a holder head will be in a definite and correct relation to the various mechanisms which operate upon the mount, I provide an indexing and locking mechanism of which one form comprises a housing 80 placed adjacent station B and carrying a slidable locating bolt 81 provided with a tapered end to enter V shaped notches 82 which, as shown in Figure 1, are cut in the rim of the rotatable table 47. Any slight inaccuracy in the angular position of the table is corrected when the wedge shaped end of the locking bolt enters one of the V shaped notches 82, and furthermore the table is firmly locked as long as the locking bolt is firmly seated in the notch. These notches 62 correspond in number to the positions taken by each holding head during the complete revolution of the table 47, although only two of the notches are shown in Figure 1, where a part of a thin sheet metal cover of the table 47 is broken away to show them. The locking bolt is yieldingly driven into the notches 82 by some automatically actuated mechanism, such as a push rod 83 driven from the cam 79 on the driving shaft 42 through a spring 84. The timing of the mechanism is such that the locking bolt enters the V shaped notch and positions and locks the table prior to the beginning of any operations of the mount, and holds the table firmly in place until after the operations at each position are completed. In the particular arrangement shown the cam 79 through the spring 84 seats the bolt 81 in the notch 82 during the first part of the upward movement of the push rod 78, while the sliding cam 77 is moving idly and before the spacing and cutting blades 74 and 76 begin to move, holds it firmly yet yieldingly seated while those blades are actuated to complete their function, and also holds it seated until after these blades have returned to their initial position.

As the mount leaves the spacing and cutting mechanism at station B it is ready to have the filament applied to it. The rotation of the table carries it to the filament applying mechanism at station C, where the filament is automatically given the proper shape and length, secured to the leads, and then cut off from the spool of wire from which the filament is formed. This filament applying mechanism includes a filament wire feeding device for supplying filament wire from a spool, a filament attaching and shaping device for securing the filament to the leads and giving it the proper shape, and a filament wire cutter for cutting the filament wire after the filament has been secured to the leads.

The operation of the filament applying mechanism can better be understood by bearing in mind the finished mount produced by the machine and shown in perspective in Figure 4. This mount consists of a metal wire or filament 85, usually of drawn tungsten, and preferably reversely curved to have an S shape, although for some types of lamps

the filament may be a straight wire extending from one lead to the other, or may be zigzag or M shaped. The ends of this filament are secured to the upper ends of two leads 86 held parallel to each other and in proper relation by the glass bead 87 which was formed around the leads when the burners 72 melted down the glass ring which was placed over the leads at a preceding position. At the time the filament is attached by the filament applying mechanism, the leads 86 are straight both above and below the bead, but subsequently the lower ends of the leads are bent into the form shown in Figure 4 to facilitate sealing the mount into the lamp.

The filament may be secured to the leads in various ways, as by bending the ends of the leads into hooks and closing the hooks upon the filament, or in any other suitable way, but I prefer to attach the filament by embedding it in the leads by pinching. The drawn tungsten wire commonly used for the filament is very much harder than the lead wire, which is usually a low expansion nickel steel wire coated with enough copper to make a composite wire that has the right coefficient of expansion to make a hermetical seal with glass. If a filament wire of drawn tungsten is placed across or in contact with such a lead and pressed upon the lead with a powerful pressure, the tungsten wire will sink into the metal of the lead and be firmly embedded in it, making a good electrical connection which is mechanically strong, as the filament wire will sink into the lead to a depth as great as its diameter and the softer metal of the lead will flow over it to some extent and lock it in place.

The sequence of operations in securing and shaping the filament will best be understood by referring to Figures 5 to 12 inclusive. As indicated in these figures, the tungsten wire 85 is fixed or embedded in the leads by two cooperating pinching jaws or pins 88 and 89 which close upon the two leads 86 and the filament 85 while the filament is so disposed that its ends overlap the ends of the leads at the point where the pinching jaws engage the filament and the leads. The filament is shaped by some suitable former which bends it and places it in proper relation to the leads. If the filament is to be given an S shape, I may use two shaping blades 90 and 91 mounted to overlap between the pinching jaws and preferably having notches in their overlapping ends to take hold of the filament wire. These blades by their overlapping not only shape the filament but also hold it in proper relation to the leads, and act as a solid block between the leads, so that as the pinching jaws close the leads can not move toward each other, but are held so rigidly that the pressure causes the filament wire to be embedded in them. By varying the extent of overlap of the shaping blades the length of filament in circuit can be varied.

The end of the filament wire 85 is first placed in the path of movement of the spaced and positioned leads held in the mount holder as shown in Figure 5, and as the movement of the table 47 carries the leads into position at station C the forward lead encounters the filament wire and swings the end of it into the position shown in Figure 6 where it is in contact with the lead and extends across it at right angles. The pinching jaws 88 and 89 with the shaping blade 90 between them, now advance bodily into the operating position shown in Figure 7 where the lead and the filament wire lying across it are both between the pinching jaw 88 and the shaping blade 90. The pinching jaw 88 now advances just enough as shown in Figure 8, to grip the lead 86 and the overlapping tungsten wire 85 so tightly between the jaw 88 and the comparatively stiff blade 90 that the end of the filament wire is held against displacement during subsequent operations. Should it happen that no mount is in place when the pinching jaws advance into operating position, the wire 85 remains in the position of Figure 5 and is merely pushed by the blade 90 in a clockwise direction and held out of range of the pinching jaws, returning to its initial position when the pinching jaws and blade 90 fall back.

The filament wire guide 92 now swings from the position indicated in Figure 7 to that indicated in Figure 9 thereby placing the filament wire 85 across the path of the other shaping blade 91, which swings with the guide 92 into the position shown in Figure 9, and then advances toward the other shaping blade 90 until it engages the filament wire 85, continuing to advance and drawing more filament wire through the guide 92 and off the spool of filament wire, until finally it overlaps the other shaping blade so far that the filament is S shaped, as indicated in Figure 10, and its ends lie transversely across the leads 86. There is no displacement of the leads, as all of the strains due to bending the filament wire and getting it into place between the leads are taken up by the shaping blades and associated mechanism. The pinching jaws now close completely as indicated in Figure 11 while the two shaping blades 90 and 91, constituting a former which substantially fills the space between the leads, hold the filament in shape and in place during the pinching which causes the filament to be embedded in the leads. The only way any variation in length of filament in circuit can occur is by displacement of the leads 86 lengthwise of the shaping blades, which is not likely to occur, as there is no force exerted during the shaping of the filament or during the pinching which is apt to cause such dis-

placement, consequently the filaments are all of very uniform length.

While the pinching jaws are still closed the filament wire guide 92 moves back into the position shown in Figures 11 and 12, leaving a considerable length of wire between the guide and the lead 86. It remains in this position while the pinching jaws open and fall back, and the shaping blades separate, as shown in Figure 12, whereupon the filament wire is cut close to the lead 86, leaving the end of the wire projecting so far that when the guide 92 swings back into the position shown in Figure 5, the end of the filament wire will be in the path of the lead, as shown in that figure.

The filament applying mechanism and the holder head for the mount are relatively movable, and are moved away from each other to permit the table 47 and holder head to move from one position to the next. When the holder head carrying the leads to which the filament is to be applied has been brought into place at station C, the filament applying mechanism and the holder head are moved toward each other so as to bring the filament applying mechanism into operative relation to the leads, as shown in Figures 8 to 11 inclusive. After the filament has been applied the filament applying mechanism and the holder head for the mount are moved away from each other into the relative positions shown in Figure 12, to permit the table 47 to carry the mount away from the filament applying mechanism. In the particular machine illustrated the filament applying mechanism is mounted so as to be bodily movable toward and away from the table 47, and the shaping blade 91 is mounted to swing back out of the way while the table is rotated. In the particular arrangement shown in Figs. 13, 14 and 15 the pinching jaws or pins 88 and 89 are normally held separated by springs and are slidably mounted in bosses 93 on a slidable block 101 having between the bosses a slot or recess containing a rectangular member 94 which carries the shaping blade 90 and is adjustably positioned by a set screw 95. By moving the member 94 in the slot the blade 90 can be set to project more or less between the pinching jaws 88 and 89. Bell cranks 96 pivoted on the bosses engage the outer ends of the pinching jaws, and are yieldingly held as by a spring 97 in engagement with a sliding cam 98 which has cam surfaces 99 and 100 so related that as the cam advances into jaw closing position the jaw 88 is closed prior to the other one. This cam is slidably mounted in guide ways in the block 101 which carries the bosses 93 and which in turn is slidably mounted to move radially of the table on a standard 102 secured to the base 40. The sliding cam 98 has a lost motion connection to the block 101 through a pin 103 in the block extending into a slot in the sliding cam. There is also a resilient connection between the cam and block through a compression spring 104 mounted between the block and a lug or projection 105 on the cam 98. To actuate both the cam 98 and the block 101, I connect the cam by a pivoted lever 106 to an actuating box cam 107 having a groove shaped as shown to impart the desired movements to the sliding cam 98 and block 101. The spring 104 is normally extended as shown in Figure 15 and is of such strength that it acts as a rigid connection between the sliding cam 98 and the block 101 as long as the block is free to move, but will yield and permit the cam to move relatively to the block if the movement of the block is stopped positively by some means such as the adjustable stop 108 mounted on the sliding block in position to engage the standard 102 when the block is in its forward position shown in Figure 14.

The filament applying mechanism is in the back position shown in Figure 15 while the table 47 is moving and in fact at all times except while the filament is being attached to the leads. When the holder head carrying the two leads stops at station C and the table is locked by the locking bolt 81, the filament wire 85 is by the filament wire feeding mechanism hereinafter described, held in position such that its projecting end overlaps one of the leads 86, as indicated in Figure 6. Cam 107 now begins to rock the arm 106 and move both the block 101 and sliding cam 98 forward, that is to the right as Figures 15 and 16 are drawn. The block 101 moves with the cam because the spring 104 is stiff and acts like a rigid connection as long as the block is free to move. At the end of the travel of the block, when it is in the position shown in Figure 14, and is in operative relation to the leads, as indicated in Figures 7 to 16, the stop 108 strikes the standard 102 and the block stops with the shaping blade 90 between the leads of the mount. The sliding cam 98 continues to move forward and the spring 104 is compressed by this forward movement. The cam 98 is now sliding on the block, and therefore being thrust between the ends of the bell cranks 96. Presently the cam surface 99 causes the corresponding bell crank to move pinching pin 88 until in cooperation with the shaping blade 90 it holds the end of the tungsten filament wire firmly in place on the lead, as shown in Figure 8, and then the cam remains stationary for a time, due to a dwell in the groove of cam 107 on the drive shaft 42, while the filament wire feeding mechanism is actuated, as hereinafter described, to draw the filament wire into the path of the other shaping blade 91, as shown in Figure 9. During these operations the other shaping

blade has been held back out of the way, as indicated in Figures 5 to 8. It now swings into its initial position shown in Figure 9, and then is automatically moved forward into position as shown in Figure 10, where it is in place between the leads and overlaps the blade 89. During this forward movement it bends the filament wire over the end of shaping blade 90 and back over the end of shaping blade 91, pulling whatever wire is needed through the wire guide 92, so that at the end of its movement the filament is S shaped and is in place between the leads. The blade 91 may be moved by various mechanisms, but the one I prefer to use is shown in the drawings and comprises an arm 109 resiliently jointed near the middle by a spring hinge 110 so the lower end on which the blade 91 is mounted can be swung to one side, as indicated in Figures 5 to 8. This arm is mounted on a rock shaft 111 actuated by a crank arm 112, the travel of which is controlled by an adjustable stop 113 which limits the travel of the crank arm and thereby of the shaping blade 91. The crank arm is actuated through a rod 114 from a cam 115 mounted on the drive shaft 41 and so timed with relation to the other parts of the mechanism and so shaped as to swing the blade 91 into place while the sliding cam 98 is stationary, and to hold it in place until after the filament is pinched into the leads.

The length of the filament is determined by the overlap of the shaping blades. The position of the blade 90 is adjusted by moving the member 94 in its slot, and the position of the other blade 91 at the end of its travel is determined by adjusting the stop 113. As the shaping blades have the same overlap and come into the same position with relation to the leads each time a filament is shaped, and as all of the leads are set at the same distance from the center of the table 48, the same length of filament is included in circuit in each mount.

When the shaping blade 91 is in place and the two shaping blades lie side by side and overlapping as shown in Figure 10, the movement of the sliding cam 98 is resumed, and now the other cam surface 100 causes the other jaw 89 to move until at the end of the travel of the sliding cam as shown in Figure 13, both pinching jaws are fully home, and the filament is firmly embedded in the leads, as indicated in Figure 11. The pinching jaws and the shaping blades now remain stationary for a period of time in the position indicated in Figure 11, while the filament wire feeding mechanism moves into position, as indicated in that figure, to leave the end of the filament wire projecting the proper distance from the wire guide 92 when the filament is cut off from the rest of the wire.

The filament wire feeding mechanism which is best shown in Figures 16 to 19, comprises the wire guide 92 which may be a block having in it a hole larger than the wire. The feed of the wire through the guide is controlled by some suitable friction or tension device, such as a spring blade 116 mounted on an arm 117 which carries the wire guide 92 on its free lower end. In many cases a pad of felt or leather under the blade 116 in position to press on the wire is of advantage. The wire can be moved lengthwise in the tension device, and will remain where it is left, so it can be set in any desired position in the guide 92 by drawing the wire through the guide and tension device. The arm 117 is pivoted to swing in a vertical plane, and has a bracket 118 provided with a spindle for a spool 119 of filament wire, controlled by a friction clamp 120 to keep the wire taut. The arm 117 is mounted near its upper end on an insulating horizontal axle formed of a tube 121 of fiber or other insulation firmly set in the arm and having in its ends firmly fitting metal plugs 122 recessed to receive the points of threaded pivots 123 which are removably mounted in the frame 124 so that by loosening the pivots the arm 117 can be removed bodily at will from the frame. The arm can be swung bodily in a horizontal plane, by moving the frame 124 about a vertical pivot 125. The position of the arm 117 is determined by an insulating stop, such as the insulating block 126 on the end of the arm in position to abut against an adjustable pin or stop threaded in the frame. The arm 117 has a rounded edge which cooperates with the end of an adjustable stationary finger 127 made of insulation, such as fiber, and secured to a standard 128 in which the pivot 125 is mounted. The pivoted frame is swung in a horizontal plane by any suitable mechanism such as a link 129 connected at one end to the frame at a point eccentric to its pivot 125 and at the other end to a crank 130 on the upper end of a vertical rock shaft mounted in a vertical pillar 131 and rocked by a crank 132 mounted in its lower end and actuated by link work 133 from a cam 134 on the drive shaft 42. When the frame 124 is in the position shown in Figure 18 the cam 117 is held back by the end of the finger 127.

The cycle of operation of the filament feeding mechanism is as follows: Assume that the wire guide 92 is in the position of Figures 1, 5 to 8, and 16, which may for convenience be called its first position, and in which the end of the wire 85, which projects from the wire guide 92, is held in the path of the leads in the advancing holder head, as shown in Figure 5. It remains in this position while the leads come into place at station C where the projecting end of the wire 85 is perpendicularly across one of the

leads, and is parallel to the line of movement of the block 101 so that at the end of the forward movement of the filament applying mechanism the lead and the end of the wire is between the shaping blade 90 and the pinching jaw 88 as shown in Figures 7 and 8. When the arm 117 is in the first position it holds the other shaping blade 91 and the lower end of the spring hinged arm 109 out of the way as shown in Figure 1 by means of a projection 135, which is mounted on the side of the spool bracket and engages the lower part of the jointed arm 109. After the pinching jaw 88 and the shaping blade 90 have gripped the end of the wire 85 as above described, and as indicated in Figure 8, the frame 124 swings in a counterclockwise direction into the second position, shown in Figure 17, where the rounded edge of the arm 117 just touches the end of the finger 127. This movement of the frame 124 permits the shaping blade 91 to return to the operative position shown in Figures 8 to 11, because the spring hinge 110 straightens out the jointed arm 109 when the spool bracket swings out of the way. The movement of the filament wire feeding mechanism from the first position to the second position stretches the tungsten wire across the path of the shaping blade 91, as shown in Figure 9, so that the filament wire is caught by the shaping blade in its forward movement, bent, and finally laid across the end of the lead which is free from the pinching jaw 88, so that the filament wire is laid across the ends of the two leads ready to be attached to them.

During the shaping of the filament the frame 124 remains stationary in the second position of Figures 9, 10 and 17, while the shaping blade 91 advances into place alongside the other blade 90 as shown in Figure 10, thereby shaping the filament and at the same time pulling as much wire as required off the spool 119, because the end of the wire is firmly held between the pinching jaw 88 and the shaping blade 90. Both pinching jaws are then actuated by the further forward movement of sliding cam 98 to sink the filament wire into the leads, and, while the jaws are closed, the filament feed mechanism moves to its third position, the frame 124 swinging further in a counterclockwise direction and causing the arm 117 to ride up on the end of the finger 127, as shown in Figure 18, and draw the arm 117 and the wire guide 92 back, as shown in Figures 12 and 18, to leave a relatively long end of wire projecting from the guide. In this movement the arm 117 tilts about its horizontal axis and the wire guide moves back along the stretched wire into the position shown in Figure 18, the tension device or blade 116 slipping along the wire which is held by the pinching jaws. The filament wire feeding mechanism is now back in its first position, but the filament is still a part of the wire on the spool 119. While the filament feeding mechanism is in this position the filament applying mechanism moves back to the position indicated in Figure 12 and shown in Figure 15.

The filament is cut off from the rest of the wire while the filament feeding mechanism is in its third position and after the pinching jaws have moved back out of the way, as indicated in Figure 12. Any suitable form of cutting device can be used but the form which I prefer, and which has been used successfully, is an electrical cutter of which the essential parts are shown diagrammatically in Figure 24. As indicated in this figure, the cutter consists essentially of two electrodes 136 mounted side by side and separated by insulation 137, which may in practice be a sheet of mica about 1/64 of an inch in thickness. The two electrodes are connected to some source of current, such as a battery, and with the size of tungsten wire ordinarily used, a potential of six volts or less is sufficient to operate the cutter. In the particular machine shown, the cutting electrodes are mounted on end of a pivoted arm 138 to which the electrical connections are made by a sliding brush or contact 139, this arm being actuated at proper intervals through a push rod 140 actuated from a cam 141 on the driving shaft 42. The mechanism is so timed that the arm is swung up to bring the cutting electrodes into contact with the tungsten wire just after the filament wire feeding mechanism has completed its cycle of movement, and the filament attaching mechanism has moved back out of the way into the position shown in Figure 15, so that at the time of cutting the parts are in the relative position indicated diagrammatically in Figure 12. The cutting electrodes swing up into contact with the wire and sufficient current flows from one electrode 136 to the other at the point of contact with the wire to sever the wire and leave the mount free.

The lower ends of the leads are now automatically bent up into shape at station D, to which the leads, with the shaped filament firmly attached to their upper ends, are now carried. This bending operation is performed by a bending and shaping mechanism best shown in Figures 27 to 31, and comprising in general two fingers which come up between the lower ends of the lead wires and then separate so as to spread the wires apart, and a die which gives the final shape by pressing the leads against the lower side of the holding jaws and thereby bending the leads to the exact shape desired. During the spreading and shaping of the lower ends of the leads the mount is still

gripped by the holder jaws and in order to avoid any displacement of these jaws by the pressure exerted during the bending and shaping of the lower ends of the leads, I provide at station D a stationary holder jaw support 142 best shown in Figure 27, and mounted on the base 40 in such a position that the outer ends of the holder jaws come under the holder jaw support when the holder head comes to station D, so that during the bending and shaping of the lower parts of the leads the holder jaws are supported at their outer ends against the thrust of the die which shapes and bends the leads.

The spreading and bending mechanism as best shown in Figures 27, 29 and 30, comprise two spreading fingers 143 mounted to move bodily into place between the leads and then separate. These fingers are normally held in contact with each other by springs and are so shaped that when they are together the ends constitute a wedge, the sharp edge of which will enter between the lower ends of the leads as the fingers are raised into position between the leads. In the particular arrangement shown these fingers are pivoted on a vertically movable head 144, sliding on vertical guide posts 145 which project from a horizontal base plate 146 secured to the frame 40. The upward movement of the head 144 is limited by a stop, such as caps 147 on the upper ends of the guide posts. This head is raised and lowered through an impositive or frictional connection comprising an actuating block 148 which slides in a groove in the head with sufficient friction to carry the head with it unless the head is positively restrained. This actuating block carries on the upper end a resiliently mounted shaping die 149 having a center notch 150 which receives the lower edge of the separator 49 when the block is in its uppermost position, in which the die cooperates with the separator and the lower sides of the holder jaws to accurately shape and bend the leads. In the preferred construction the die is mounted on a bracket 151 on the upper end of a rod 152 which is in effect splined on the block 148 by being slidably fitted in a vertical hole in the block and provided with a slot 153 to receive the inner end of a pin 154 mounted in the block to limit the movement of the rod 151. The die is cushioned by a spring connection between it and the actuating block, such as a coiled compression spring 155 placed at the bottom of the hole in the block to engage the lower end of the rod 152 and normally hold the rod in its uppermost position. The sliding block is raised and lowered by any suitable mechanism; for example it may have a bracket 156 fastened to it to connect it to a push rod 157 actuated from a cam 158 on the driving shaft through a connection such that the sliding block is positively moved in both directions. This can be accomplished in various ways, as for example, by the arrangement in which a slotted link 159 on the shaft is provided with two rollers which engage opposite points on the cam, one of these rollers being in contact with the cam when the block is moved upward and the other when the block is moved downward.

The separating and shaping mechanism is normally in the position shown in Figure 27 so that the mount can be carried into operative relation to it without interference. As the mount in the holder comes to station D the outer ends of the holder jaws come under the holder jaw support 142 as shown in Figures 27 and 28. Presently the head 144 begins to rise, sliding on the guide posts 146 and raising the fingers 143 until their ends are into place between the leads 86. This will occur even though the leads are close together, because the sharp edge of the wedge formed by the ends of the spreader fingers, will enter between the leads under almost any condition encountered in practice. The friction between the sliding block and the head 144 is sufficient to raise the head and the fingers without any relative movement of the parts until the head is positively stopped, as by encountering the stops or caps 147 at which time the parts are in the position shown in Figure 29 with the ends of the fingers, as shown in dotted lines between the leads and close to the lower edge of the separator. The actuating sliding block 148 continues to move upward and is now moving in the groove in the head 144 because the head is positively restrained by the cap on the guide posts. As a result of this movement of the block relatively to the head, the block is thrust in between the pivoted spreading fingers 143, acting like a wedge to separate them and move them into the position shown in Figure 30. This separating or spreading movement of the fingers carries the ends of the leads so far apart that as the actuating block 148 continues its upward movement the leads are spread out practically at right angles to the path of the block, so that by the time the shaping die 149 comes in contact with the leads they are across the face of this shaping die practically at right angles to the path of the block and are in the most favorable position to be shaped. The sliding actuating block 148 with the shaping die yieldingly mounted on it continues its upward movement, during which the separator 49 of the holding head enters the slot 150 in the shaping die, and at the end of the upward travel of the sliding block the shaping die yieldingly seats on the lower sides of the holder jaws, positively pressing and forming the lower ends of the leads into the shape shown in Figure 4. In effect each

pair of leads is bent and shaped in a die, and therefore all of them are uniform, which is a marked advantage in lamp manufacture.

The mount is now completed and is of the form shown in Figure 4. As the table rotates and the holder containing the finished mount moves to the final or discharging station E the stationary cam 54 shown in Figure 1 automatically opens the holder jaws by pulling back the wedge 57. The finished mount can now be removed by hand or by various forms of automatic devices.

The automatic discharge device which I prefer, shown in Figures 32 to 34, is of the conveyor type, constructed to automatically pick up the finished mount and carry it out of the holder jaws to the delivery point, where it will be automatically discharged. This discharge device will also, if desired, apply a coating to the bend of the leads, as indicated in Figure 35. This discharge conveyor has a frame which overhangs the table 47 at the discharge position and carries a sprocket wheel 160, directly over the table and another similar wheel 161 at the discharge point where the mounts are dropped. A chain belt 162 having pairs of conveyor jaws 163 runs on these wheels, the conveyor jaws being pivoted on the chain by pivots 164 which project beyond the sides of the chain. The conveyor jaws take hold of the leads of the finished mount between the filament and the head. These jaws, as best shown in Figure 34 are normally resiliently held closed by some means such as the spring 165. One of the jaws of each pair is provided with an actuating member, such as a bell crank with a projecting pin 166. The jaws are automatically opened in the position where the finished mount is taken from the mount holder and also in the discharge position where the finished mount is automatically dropped. The automatic control of the jaws is preferably effected by stationary cam 167 mounted adjacent the sprocket wheels in such a position that as each pair of jaws is carried around the sprocket wheel by the chain the pin 166 on the bell crank rides up on the cam, which is of such an extent and contour as to hold the jaws open until they are on the lower side of the sprocket wheel and in position to pick up the mount in the mount holder or to drop the finished mount at the other end of the device. The conveyor chain is given a step by step movement in some suitable way, as by a ratchet wheel 168 connected to the sprocket wheel 161 and actuated by a rocking arm 169 carrying a pawl 170 and rocked by a push rod 171 from a cam 172 on the drive shaft 41. The parts are so timed that during movement of the table 47 the conveyor chain is stationary and a pair of jaws are held open on the lower side of the sprocket wheel 160 over the table in such a relation to it that the finished mount in the mount holder is carried in between the jaws by the movement of the table which brings the mount holder into the final or discharge position. The conveyor chain then begins to move, whereupon the conveyor jaws close, due to the actuating pin 166 of one of the jaws riding off the high part of the cam 167. As the jaws close under the pull of the spring 165, they grip the leads of the mount between the filament and the bead, and sweep the mount out from between the holder jaws. The pair of conveyor jaws carrying the finished mount then travel over to the other sprocket wheel 161 where the jaws are automatically opened by the pin 166 riding up on the stationary cam 167 adjacent that wheel and the mount is dropped.

In addition to automatically removing the finished mount from the machine, this discharge mechanism can also be used to apply a paste or similar compound to the bends of the leads. To do this the mounts while held in the jaws are carried to a device which automatically applies the paste. The particular arrangement which I prefer is shown in the drawing and comprises a horizontal steadying guide bar 173 on which the projecting pivots 164 of each pair of jaws slide as the mount is carried from the machine to the discharge position. At a point in the path along which the mounts are carried, I provide a paste applying means such as a wheel 174 having a groove cut in the rim to leave two ridges at a slightly greater distance apart than the spacing of the leads. This wheel is mounted so that the lower edge dips into the semi-liquid paste material which is contained in a cup 175. The parts are so positioned, as shown in Figure 33, that as the finished mounts are carried along by the discharge mechanism the bends of the mount come into contact with the ridges on the wheel 174 and as the wheel is coated with the semi-liquid paste some of it adheres to the bends of the leads and forms beads 176 of paste as indicated in Figure 34. This paste, which may be lead borate or similar material, facilitates making a good hermetical seal between the glass and the lead wire 86. The coated mount then passes along to the final discharge position and during its travel to that position the paste dries so that when the mount is finally released by the automatic opening of the conveyor jaws, the paste is dry and the mount is ready to be sealed into a lamp.

The operation of the machine will now for convenience be explained by considering the various operations in succession, from the placing of the leading-in wires in the holder head to the removal of the finished mount ready for use.

The holder heads are carried by the table 47 which has a step by step movement such

that during one revolution of the table each head stops for a certain length of time in twelve different positions, and is accurately positioned and firmly held in each position by the indexing and locking bolt 81 which corrects any error in the angular movement of the table.

As seen in Figure 1, the holder jaws 48 are open at the final or discharge station E and remain open while the holder head is moved from that station to its first position at station A. While the jaws are open the leading-in wires are automatically fed into place, and their ends are seized, as shown in Figure 2, by gripping jaws 61, which hold them as the feed tubes 58 drop back into their initial position, exerting enough pull, due to the friction of the clutches 59, to straighten out any bends or kinks in the leading-in wires and to hold the straightened wires rather taut. The holding jaws 48 now close, firmly clamping the lead wires to the separator 49, and remain closed until the completed mount is removed from the machine. The lead wires are then cut by the shears 67 below the holder jaws 48, leaving such a length of wire projecting from the feed tubes 58 that the gripping jaws 61 will catch the ends of the wires when the feed tubes are again in their uppermost position, as shown in Figure 2. By this mechanism at station A the two leads are placed in the holding head with their upper ends projecting some distance above the head.

The holder head with the leads firmly gripped in its jaws 48 is then carried by the step by step movement of the table 47 through its second and third positions, in one or the other of which the operator places over the upwardly projecting ends of the leads the ring of glass which is melted down to form the bead 87. In the fourth and fifth positions this ring is within range of the burners 72, and is melted down into a bead or button 67 in which the two leads are firmly embedded the proper distance apart.

When the holder head arrives at the seventh position at station B it is in operative relation to the spacing and positioning mechanism with the upper ends of the leads between the blades 74 and 76. As the blades approach each other the leads are first pushed to the bottom of the two notches 75 in blade 74, which stops with the bottoms of those notches at a predetermined distance from the axis 46 of the table, so that the two leads are not only spaced a definite distance apart, but are positioned a definite distance from the axis of the table. The surplus length of lead is then sheared off by further movement of the blade 76 over the blade 74.

The two leads, accurately spaced apart and accurately positioned radially of the table, are now carried to station C, where the filament is applied. As the leads approach station C the filament feeding mechanism takes up a position substantially as shown in Figure 5 in which the wire guide or holder 92 holds the end of the wire in the path of the oncoming leads and when the leads stop at station C the end of the wire overlaps one of the leads, as shown in Figure 6. The filament applying mechanism now advances, and as previously explained, grips the lead and the overlapping end of the filament wire between the pinching jaw 88 and the shaping blade 90, as shown in Figure 8, firmly holding the wire and the lead. The filament feeding mechanism now swings the frame 124 and associated parts, including the spool 119 of filament wire, in a counterclockwise direction, stretching the wire into the position shown in Figure 9 and permitting the spring hinged arm 109 to straighten out and bring the shaping blade 91 into the position of Figure 9. Then the shaping blade 91 is swung toward the other blade 90 by the rock shaft 111, catching the wire and bending it over the end of the shaping blade 90, and also shaping it into a reverse curve as indicated in Figure 10. Whatever length of wire is necessary to form this reverse curve is drawn off the spool 119 by the blade 91 during its movement, as the end of the wire is held immovable by the pinching jaw 8. The direction of the movement of the shaping blade 91 and its relation to shaping blade 90 and the other parts of the mechanism are such that practically all of the strains due to the bending and shaping of the wire are taken up by the shaping blades 90 and 91, and the reversely curved wire is put in place between the leads without displacing either of them. The filament wire is now reversely curved and is on the two overlapping shaping members 90 and 91, which are of such a thickness as substantially to fill the space between the two leads. The pinching jaws now advance toward each other into the position of Figure 11, the jaw 88 pressing the filament wire against one lead, which is supported by the shaping blade 90, and the jaw 89 pressing the other lead against the filament wire, which is supported by the blade 81, thereby pinching the leads and the wire together where they are in contact and causing the wire to sink into and be embedded in the leads. While the pinching jaws are closed the wire guide 92 is moved back along the wire a short distance, due to a further counterclockwise movement of the frame 124 sufficient to cause the arm 117 to be swung back as shown in Figure 18 and the wire guide to move back along the wire into the position shown in Figure 11, so that when the wire is cut near the mount there will be left projecting from the guide a portion of the wire long enough to bring the end of the wire into the path of the oncoming leads when the wire guide returns to the position shown in Figures 5 and 6. The fila-

ment is now shaped and is secured to the leads, but is still part of the wire on the spool 119. In order to free the mount from the rest of the wire the filament applying mechanism falls back into the position shown in Figure 14, and thereupon the cutter, consisting of electrodes 136, is brought into contact with the wire by movement of the swinging arm 138 and the arc between the electrodes separates or cuts the wire near the lead, as indicated in Figure 12.

The mount with the filament in place is now carried to station D, where the lower ends of the leads are spread apart by the spreading fingers 143 and finally shaped by the die 149. The spreading and shaping mechanism then drops back into the position shown in Figure 27 leaving the mount free to be carried to the next position.

The mount is now completed, and by the further movement of the table 47 is carried finally to its twelfth position at station E, where the holding jaws are automatically opened by the stationary cam 54, so that the mount can be removed from the holder head. As it moves into this position the completed mount came into place between the open jaws 163 of the conveyor discharge device, and while the holder head with the jaws open is at station E the chain 162 moves, causing the conveyor jaws 163 to sweep the finished mount out from between the holder jaws 46 and to grip it between the filament and the bead. The mount is now carried along by the chain 162, the paste is automatically applied to the leads to produce the beads 173, as shown in Figure 35, and by the time the mount reaches the discharge end of the conveyor the paste is dry, so that when the conveyor jaws 163 automatically open at the discharge end of the conveyor they release a finished mount ready to be put into a lamp.

It will be noted that this machine performs automatically all of those operations which must be performed with accuracy if the mounts are to be uniform, and also performs automatically other operations, such as placing the leads in the holder head and shaping the leads, which requires skill. With this machine the operator need only place the glass rings for the beads over the leads, and even this could be done automatically if desired.

While I have described this machine as a machine for making lamp mounts, it is not restricted to such use, but can be used in making many other articles, such as fuses, detonators, and similar articles in which a predetermined length of wire is secured to two other wires or supports. Furthermore, numerous structural alterations may be made in the machine without departing from my invention, and I wish it to be understood that my invention comprehends all alterations and modifications which fall within the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In apparatus of the character described, the combination of a holder for a pair of leads, filament applying mechanism for securing a filament to the leads in said holder, and actuating means for moving said holder and said filament applying mechanism relatively to each other to bring said holder into and hold it stationary in operative relation to said mechanism and to operate said mechanism while said holder is stationary to place the other end of the filament in contact with the leads and then automatically attach both ends of the filament permanently to the leads in said holder.

2. In apparatus of the character described, the combination of a holder for holding a pair of leads with projecting ends side by side, a spacing mechanism for setting the projecting ends of the leads in said holder a predetermined distance apart, a filament applying mechanism, and actuating means for producing intermittent and relative bodily movement of said holder and said mechanisms to bring said holder into and hold it in operative relation with said spacing and filament applying mechanisms in succession and to actuate each of said mechanisms while said holder is in operative relation to it.

3. In apparatus of the character described, the combination of a bodily movable holder for holding a pair of leads with projecting ends side by side, a spacing mechanism for spacing the projecting ends of the leads in said holder, filament applying mechanism for automatically securing a filament to the spaced ends of the leads in the holder, bending mechanism for bending the projecting free ends of the leads into a predetermined shape, and actuating means for intermittently bringing said holder into and stopping it in operative relation to each of said mechanisms in succession and for actuating said mechanisms while said holder is in operative relation with it.

4. In apparatus of the character described, the combination of a bodily movable holder for a pair of leads, an automatic wire feeding mechanism for placing two leads in said holder, a spacing mechanism for spacing the projecting ends of the leads in said holder, a filament applying mechanism for automatically securing the filament to the spaced ends of the leads, a bending mechanism for bending and shaping the free ends of the leads, and common actuating means for actuating said mechanisms and said holder to bring said holder into and stop it in registry with each of said mechanisms in succession and to actuate each

mechanism while said holder is in registry with it.

5. In apparatus of the character described, the combination of a bodily movable holder for holding a pair of lead wires with projecting ends side by side, means for clamping one end of a filament wire in contact with and perpendicular to a lead wire in said holder, means for bringing a remote portion of said wire into contact with the other lead, pressing said filament and lead wires together to secure them to each other, and common actuating means for said holder and said other means.

6. In apparatus of the character described, the combination of a holder for a pair of lead wires, means for clamping the end of a filament wire to one of the lead wires in said holder, a filament wire holder movable to lay the filament wire across and in contact with the other lead wire, securing means for fastening the filament wire to both lead wires at the points of contact, and actuating means for actuating said clamping means, said filament wire holder, and said securing means in sequence.

7. In apparatus of the character described, the combination of a holder for holding a pair of leads with projecting ends side by side, a filament wire holder for holding a filament in contact with the leads in said holder, a filament applying mechanism comprising a former movable into position between the ends of said leads and cooperating means for exerting pressure in the line of said leads to fasten the wire to the leads, and means for actuating said holders and said mechanism in sequence.

8. In apparatus of the character described, the combination of a holder for a pair of lead wires, a filament wire holder movable to bend a filament wire into place with its ends in contact with both leads, pinching means comprising a former movable into place between said leads and cooperating jaws movable in the line of said leads for embedding said filament wire in both lead wires at the points of contact, and means for actuating said wire holder and said pinching means in sequence.

9. In apparatus of the character described, the combination of a holder for a pair of leads, a filament applying mechanism for securing a filament wire to leads in said holder and comprising pinching jaws movable toward each other, a movable shaper for shaping the filament wire and movable into place between said jaws, and actuating mechanism for bringing said holder into registry with said mechanism, moving said shaper into place between said jaws, and moving said jaws toward each other.

10. In apparatus of the character described, the combination of a lead wire holder, a filament applying mechanism comprising a pair of co-operating pinching jaws for securing a filament wire to lead wires in said holder, a blade co-operating with one of said jaws to form a clamp, a wire holder normally in position to hold the end of a filament wire between said jaw and said blade and movable toward the other jaw, a second blade movable into place between said jaws to overlap the first blade, a wire cutter movable into operative position adjacent said other jaw, and actuating means for bringing said lead wire holder and said mechanism into registry and for actuating in sequence said first mentioned jaw, said wire holder, said second blade, said other jaw and said cutter.

11. In apparatus of the character described, the combination of a lead wire holder, a filament applying and shaping mechanism bodily movable toward and away from said holder and comprising co-operating jaws for securing a filament to the leads in said holder and means for shaping a filament and placing it between said jaws, a cutter movable into cutting position adjacent one of said jaws, and actuating means for moving said mechanism forward bodily to bring it into registry with said holder, actuating said mechanism to shape and secure a filament, moving said mechanism bodily away from said holder, and actuating said cutter.

12. In apparatus of the character described, the combination of a movable carrier, a holder on said carrier for holding a pair of leads, a filament applying mechanism mounted to move bodily transversely of the direction of movement of said carrier and comprising co-operating jaws for securing a filament to the leads in said holder, and actuating means for moving said carrier to bring said holder into alignment with said mechanism and to move said mechanism toward said carrier to bring said mechanism and said holder into registry and to close said jaws.

13. In apparatus of the character described, a filament applying mechanism comprising a pair of co-operating pinching jaws, two relatively movable shaping blades mounted to overlap between said jaws, means for varying the extent of overlap of said blades, and common actuating means for said blades and said jaws.

14. In apparatus of the character described, a filament applying mechanism comprising a pair of co-operating pinching jaws, two relatively movable shaping blades mounted to overlap between said jaws, and actuating means for causing said blades to overlap and said jaws to close in sequence.

15. In apparatus of the character described, a filament applying mechanism comprising a pair of pinching jaws, a shaping blade between said jaws, a second shaping

blade mounted to be moved into position alongside said first blade and to overlap it, and actuating means for bringing said movable shaping blade into position between the said jaws to overlap the first blade, and for moving said pinching jaws toward each other.

16. In apparatus of the character described, a filament applying mechanism comprising a block, pinching jaws mounted on said block to move toward each other, and a sliding cam mounted on said block to actuate said jaws by movement of said cam on said block.

17. In apparatus of the character described, a filament applying mechanism comprising a pair of co-operating pinching jaws, a shaping blade positioned between said jaws, a cam for actuating said jaws and shaped to move one jaw toward said blade prior to moving the other jaw, a filament wire holder mounted to hold the end of a filament wire in the path of the first mentioned jaw and movable to carry the wire toward the other jaw, a second shaping blade movable into place beside the first blade, and means for actuating said cam to move said first mentioned jaw, said wire holder, and said second shaping blade in sequence and further actuating said cam to close both jaws.

18. In apparatus of the character described, a filament shaping and applying mechanism comprising a pair of co-operating pinching jaws mounted to move bodily in a direction transverse to their opening and closing movement, a shaping blade mounted to move in the direction of bodily movement of said jaws and movable into place between said jaws, a filament wire holder mounted to move across the path of said shaping blade and also away from said jaws, a wire cutter movable into operative position adjacent one of said jaws, and actuating means for moving said wire holder and said blade, closing said jaws while closed, opening said jaws and moving them away bodily, and actuating said cutter.

19. In apparatus of the character described, a filament applying mechanism comprising a slidably mounted block, pinching jaws mounted on said block, a cam slidably mounted on said block to actuate said jaws by movement relative to said block, a lost motion connection between said cam and said block, a resilient connection between said cam and said block to normally hold said cam in jaw opening position on said block, actuating means for moving said cam toward jaw closing position and thereby moving said block by said resilient connection, and means for stopping said sliding block in a predetermined position during the movement of said cam whereby further movement of said cam causes relative movement of said cam and block and closes said pinching jaws.

20. In apparatus of the character described, a filament applying mechanism comprising a pair of co-operating pinching jaws, a filament shaper movable into place between said jaws, a filament wire holder mounted to move in the direction of a line joining said jaws and across the path of said shaper, and common actuating means for said shaper, said pinching jaws, and said wire holder.

21. In apparatus of the character described, a filament applying mechanism comprising a pair of pinching jaws, a filament shaper comprising two shaping blades movable into position to overlap between said jaws, a filament wire holder movable across the path of said shaping blade to place a filament wire in position to be caught by one of said blades and carried into place between said jaws, and actuating means for actuating said wire holder, said shaping blade, and said pinching jaws in sequence.

22. In apparatus of the character described, a filament wire holder comprising a frame pivoted to swing in a horizontal plane, a wire holding arm pivoted in said frame to swing in a vertical plane, actuating means for said arm rendered operative by movement of said frame into a predetermined position, and actuating means for swinging said frame horizontally into and out of said position.

23. In apparatus of the character described, a filament wire holding mechanism comprising a horizontally movable frame, a wire holding arm pivoted on said frame to swing in a vertical plane, a stationary cam mounted in position to encounter said arm and swing it about its pivot near the end of the travel of said frame, and actuating means for swinging said frame back and forth in a horizontal plane.

24. In apparatus of the character described, the combination with a rotatable table having a holder for a pair of leads and provided with a notch in its rim, a mechanism mounted adjacent the rim of the table to co-operate with the leads in said holder when it is in registry with the mechanism, a locking bolt movable radially of the table to enter said notch and mounted adjacent the rim of the table to position it with said holder in registry with said mechanism when said locking bolt is seated in said notch, and common actuating means for in succession moving said table to bring said holder into registry with said mechanism, seating said locking bolt in said notch to lock said table in position, and operating said mechanism while said holder is in registry with it and said table is locked.

25. In apparatus of the character described, the combination with a holder for

wire, of gripping jaws mounted on one side of said holder, feed mechanism on the other side of said holder for feeding a wire into the holder and said jaws and for exerting a pull on the wire while held by said jaws, and means for actuating said jaws and mechanism to cause said jaws to seize the ends of a wire fed into said holder and to exert a pull on the wire to straighten it while seized by said jaws.

26. In apparatus of the character described, the combination of a holder having movable holding jaws, a gripping device adjacent said holder, a feed mechanism for feeding a wire into said holder and said gripping device and for exerting a pull on the wire to straighten it while held in the gripping device, and means for actuating said device and mechanism to feed a wire into said holder and straighten it while said holding jaws are open and then close the holding jaws upon the wire.

27. In apparatus of the character described, the combination of a holder for wires, a gripping device for seizing the ends of wires in place in said holder, feeding mechanism for feeding wires into said holder with their ends in said gripping device and for exerting a pull on said wires to straighten them while seized by said gripping device, and common actuating means for said gripping device and said feed mechanism.

28. In apparatus of the character described, the combination of a wire holder mounted to move bodily and intermittently, straightening means mounted adjacent the path of said wire holder and comprising a member movable along the wires in said holder for exerting a pull to straighten them, and actuating means for bringing said holder into registry with said straightening means and then moving said member to straighten the wires.

29. In apparatus of the character described, the combination of a wire holder mounted to move bodily and intermittently, and wire straightening means mounted adjacent the path of said wire holder and comprising gripping jaws, a member movable toward and away from said jaws and impositively connected to the wire to be straightened, and actuating means for holding said jaws open and moving said member toward them, closing said jaws on the wire, and moving said members away from the jaws to exert a pull on the wire to straighten it.

30. In apparatus of the character described, the combination of a horizontally movable head comprising co-operating holder jaws, gripping jaws mounted above the path of said head, a feeding mechanism for moving lead wires vertically to place them between holder jaws with their ends projecting above said jaws into said gripping jaws and for exerting a pull on said wires to straighten them, a shear for cutting said wires below said holder jaws, and means for actuating said feed mechanism and gripping device to straighten the wire and for then closing the holding jaws and actuating said shear.

31. In apparatus of the character described, the combination with a holder head comprising relatively movable jaws, of a feeding mechanism comprising wire clutches mounted to move perpendicular to the plane of movement of said jaws to place side by side in said jaws a pair of lead wires threaded through said clutches, means for moving said clutches toward the jaws to place the lead wires in said jaws and for retracting said clutches along the wires held by said jaws, a cutter for cutting the wire between the ends of said tubes and said holder jaws, and means for actuating said holder jaws, feed mechanism, and cutter in predetermined sequence.

32. In apparatus of the character described, the combination with a movable carrier of a holder head for a pair of leads comprising a stationary member projecting from said carrier, a pair of jaws movably mounted on the carrier to close upon opposite sides of said member, resiliently actuating closing mechanism for said jaws, and actuating means for controlling said closing mechanism for said jaws.

33. In apparatus of the character described, the combination with a movable carrier of a holder head comprising a separator mounted on said carrier, pivoted jaws mounted on said carrier to close upon opposite sides of said separator, a spring pressed wedge mounted to enter between the opposite ends of said pivoted jaws and thereby close said jaws upon said separator, and actuating means for retracting said wedge to permit said jaws to open.

34. In apparatus of the character described, the combination of a rotatable table having a rigid separator projecting from its edge, a pair of holder jaws pivoted intermediate their ends on opposite sides of said separator to close upon said separator, a spring actuated wedge mounted to move radially of the table and to enter between the ends of said pivoted jaws to close their other ends upon the separator, means movable radially of the table for positively moving said wedge from between the ends of said jaws to permit said jaws to open, and common actuating means for actuating said table and said jaw controlling mechanism to open and close said jaws at a predetermined point in the revolution of the table.

35. In apparatus of the character described, the combination of a holder for holding a pair of wires with their ends pro-

jecting side by side and a spacing mechanism for the ends of said wires comprising two co-operating blades movable toward each other, one provided with a wedge shaped projection mounted to enter between the wires in said holder, and the other movable over the first blade to a point near the base of said wedge shaped projection.

36. In apparatus of the character described, a spacing mechanism comprising a spacing blade having two tapered notches with their bottoms a predetermined distance apart, a co-operating blade movable over the first blade toward the bottom of said notches, a bodily movable holder for holding a pair of wires side by side with their ends projecting, and actuating means for moving said holder to bring the wires in it into registry with the notches in said spacing blade and for moving said blades toward each other.

37. In apparatus of the character described, the combination of a holder for a pair of leads, a spacing mechanism for said leads mounted adjacent the path of travel of said holder and comprising two blades normally separated to permit the pair of leads in the holder to be brought between said blades by movement of said holder, one of said blades having a wedge shape and adapted to enter between the leads in the holder and separate them to a predetermined distance and the other blade mounted to slide over the first blade on the base of said wedge shaped portion, and common actuating means for moving said holder to bring it into registry with said spacing mechanism and to move said blades toward each other while said holder and said mechanism are in registry.

38. In apparatus of the character described, the combination with a wire holder for holding a wire with its end projecting and mounted to travel in a predetermined path, of positioning means mounted adjacent the path of said holder and movable across said path to move the end of the wire in said holder transversely of the path of the holder and thereby position the end of the wire.

39. In apparatus of the character described, the combination with a wire holder mounted to travel in a predetermined path, of a member having a notch to engage a wire in said holder and movable transversely of the path of travel of the holder into a predetermined relation to said path and thereby position said wire, and means for actuating said holder and said member.

40. In apparatus of the character described, the combination with a wire holder mounted to travel in a circle, of means operative at a predetermined point in the travel of said holder to move a wire in said holder radially to set it at a predetermined distance from the center of the circle in which the holder travels.

41. In apparatus of the character described, the combination with a wire holder mounted to travel in a circle, of positioning mechanism adjacent the circular path of said holder and comprising a member movable radially of said circular path to set a wire in said holder at a predetermined distance from the center of said path, and means for moving said member radially to a predetermined position while said holder is in registry with said mechanism.

42. In apparatus of the character described, the combination with a travelling holder for a wire, of a positioning mechanism comprising co-operating members movable toward each other and transversely of the path of said holder, one of said members having a notch to engage a wire in said holder, and means for actuating said holder and said members while said holder is in registry with said mechanism to move said notched member to a predetermined position and also moves said other member to carry a wire in said holder to the bottom of the notch.

43. In apparatus of the character described, the combination of a holder for holding two wires side by side with projecting ends, a bending mechanism comprising two separable fingers normally held close together, and actuating means for moving said holder and said mechanism relatively to each other to bring them into registry and then moving said fingers into position between the free ends of the wires in said holder and then actuating said fingers to move their ends perpendicular to said wires and thereby spread said wires.

44. In apparatus of the character described, the combination of an intermittently movable wire holder for holding a pair of wires with their ends projecting side by side and a bending mechanism mounted adjacent the path of said holder and comprising a movable head, spreading fingers pivoted on said head and normally held with their ends in contact, an actuating block impositively connected to said head to move it bodily and thereby bring the ends of said closed fingers into a predetermined position and then move relatively to said head and thereby spread said fingers in a direction perpendicular to direction of movement of the head and common actuating means for moving said holder and said block in synchronism.

45. In apparatus of the character described, the combination of a movable holder for holding a pair of wires with their free ends projecting and substantially parallel, a bending mechanism mounted adjacent the path of the holder and comprising a head movable toward and away from the wires in said holder, spreading fingers on said head

with their ends normally together and mounted to be separated in the direction of a line joining the wires and perpendicular to the direction of movement of said head, a movable actuating block impositively connected to said head to carry said head with it while said head is unrestrained and to move relatively to said head to enter between said fingers and thereby separate them when the head is restrained, and actuating mechanism for said mechanism for bringing said holder into registry with said bending mechanism and thereafter moving said block to carry said head toward said holder and thereby place the ends of said fingers between the leads and then separate the ends of said fingers while said head is restrained and thereby bend said leads away from each other.

46. In apparatus of the character described, the combination of a holder for holding two wires with their ends projecting, a shaping die mounted to move toward said holder to cooperate with the end of said holder and shaped to spread said wires apart and to bend them to predetermined shape between said shaping die and the end of said holder, and common actuating means for producing relative movement of said holder and said die to bring them into registry and into operative relation while in registry.

47. In apparatus of the character described, the combination of a holder for holding two wires with their ends projecting and side by side, a shaping die having a recess corresponding in shape to that surface of said holder from which the wires project, and common actuating means for bringing said holder and said die into registry and while in registry for moving said die toward said surface to shape said wires between the holder and the die.

48. In apparatus of the character described, the combination of a holder for holding two wires with their ends projecting and side by side, a shaping die having a recess corresponding in shape to that surface of said holder from which the wires project, a resilient mounting for said die, and common actuating means for bringing said holder and said die into registry and while in registry pressing said die against said holder to shape the wires between said holder and said die.

49. In apparatus of the character described, the combination of a holder for holding two wires with their ends projecting and side by side, a shaping die shaped to bend said wires to definite shape between said holder and said die, spreading fingers normally held together and forming a wedge and movable with said die to enter between the wires and separable to spread said wires, and actuating means for producing relative movement of said holder and said die to bring them into registry and while in registry for moving said die to insert said fingers between the wires and separate the fingers to spread the wires and then bring said die adjacent said holder to shape the wires between said die and said holder.

50. In apparatus of the character described, the combination of a holder having movable co-operating jaws with free ends, a shaping die co-operating with said jaws to shape a wire held in and projecting from them, said die exerting on said jaws a pressure tending to displace their free ends, and a jaw support mounted adjacent said die to support the free ends of said jaws against displacement by pressure of the die, and common actuating means for moving said holder and said die relatively to each other to bring them into registry and while in registry moving said die to exert a pressure on said jaws.

51. In apparatus of the character described, the combination with a movable carrier having horizontally projecting holder jaws, of a vertically movable shaping die mounted adjacent the path of said holder jaws and movable toward them to bend into shape a wire extending from them, and a stationary jaw support mounted to engage the free ends of said jaws and support them against the thrust of said die, and actuating means for bringing said holder into registry with said die, and then moving said die bodily toward said jaws while in registry with said jaws.

In witness whereof, I have hereunto set my hand this 23d day of November, 1921.

MICHAEL E. McGOWAN.