

July 6, 1926.

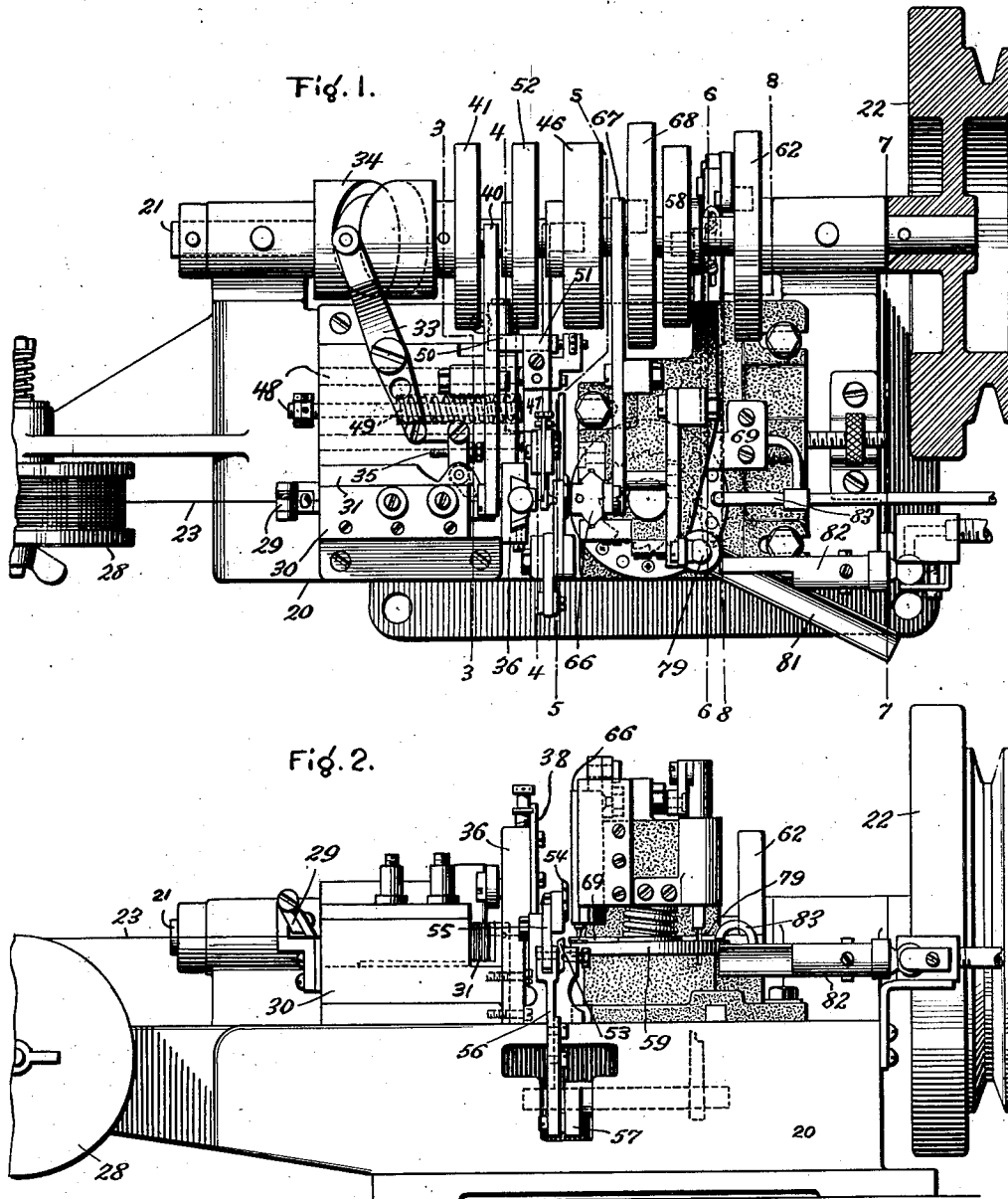
1,591,833

V. G. JARMAN

METHOD OF AND MACHINE FOR FORMING FILAMENTS

Filed Oct. 16, 1923

4 Sheets-Sheet 1



Inventor
Vincent G. Jarman,
by *Alexander S. Lutz*
His Attorney

July 6, 1926.

1,591,833

V. G. JARMAN

METHOD OF AND MACHINE FOR FORMING FILAMENTS

Filed Oct. 16, 1923

4 Sheets-Sheet 2

Fig. 3.

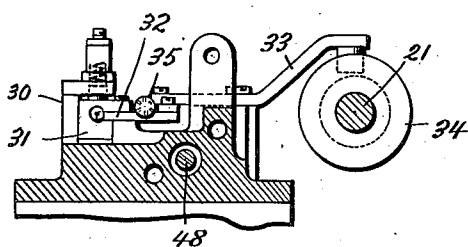


Fig. 4.

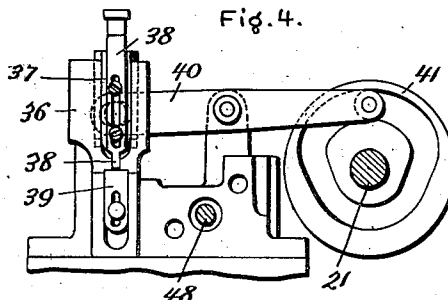


Fig. 5.

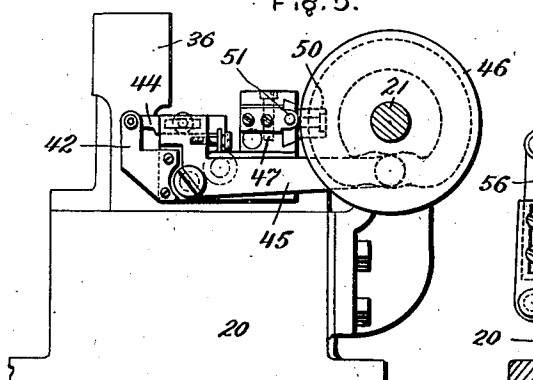


Fig. 6.

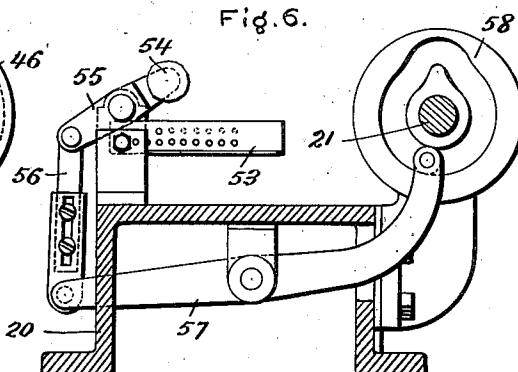


Fig. 8.

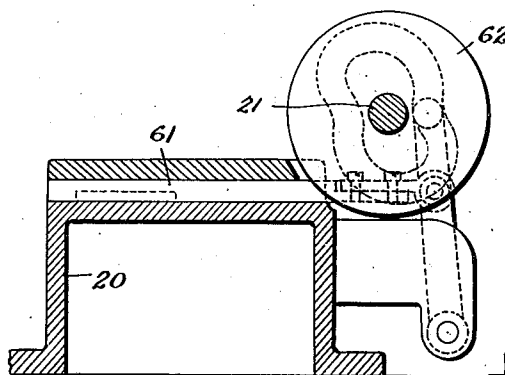
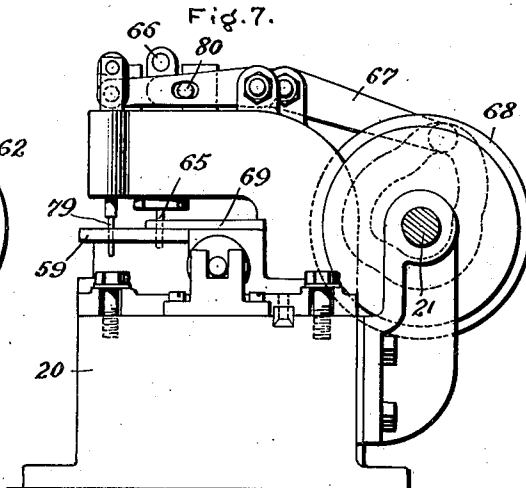


Fig. 7.



Inventor:
Vincent G. Jarman.

by *Alexander S. Smith*
His Attorney

July 6, 1926.

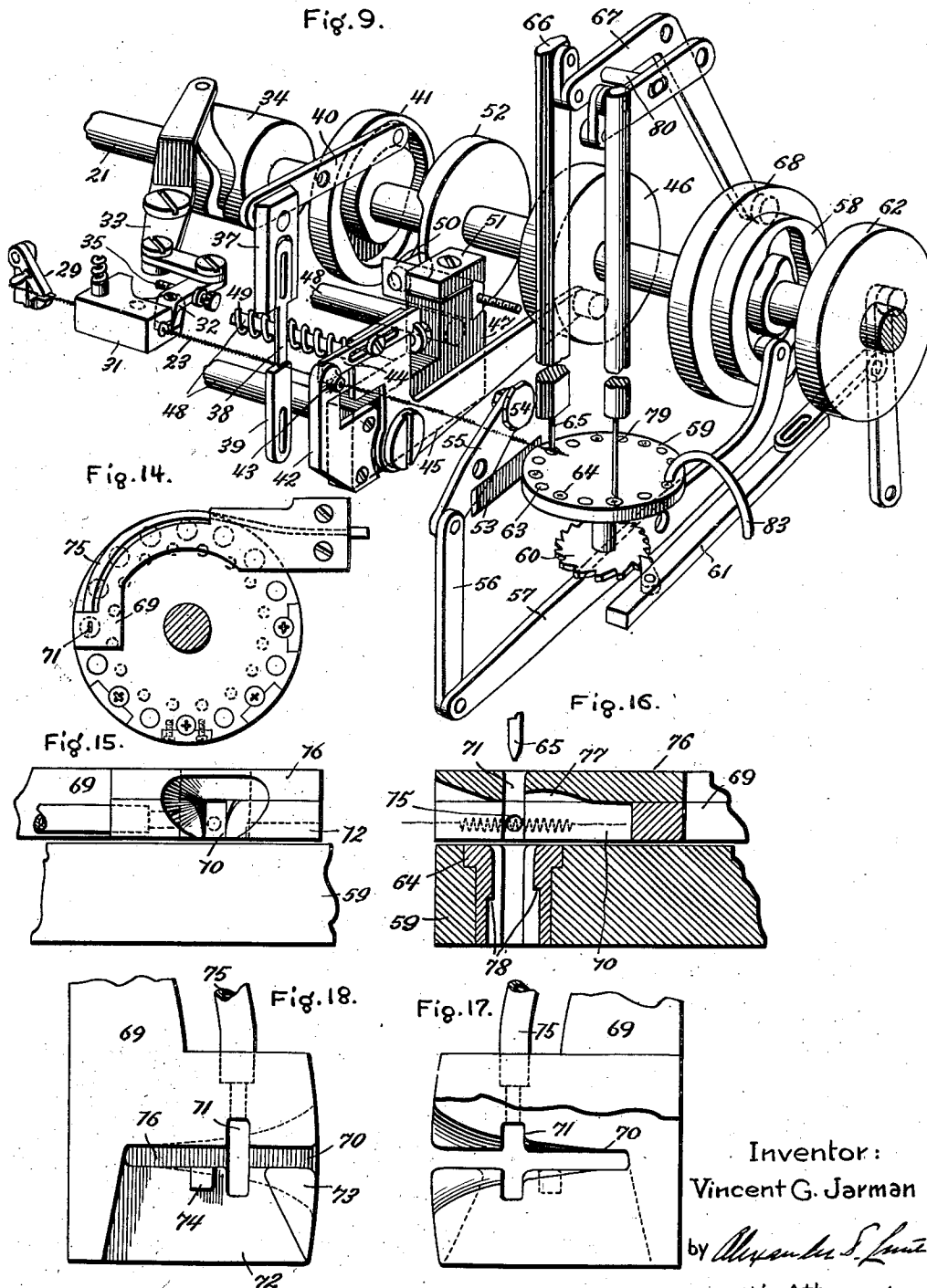
1,591,833

V. G. JARMAN

METHOD OF AND MACHINE FOR FORMING FILAMENTS

Filed Oct. 16, 1923

4 Sheets-Sheet 3



Inventor:
Vincent G. Jarman
by *Alexander S. Lane*
His Attorney

July 6, 1926.

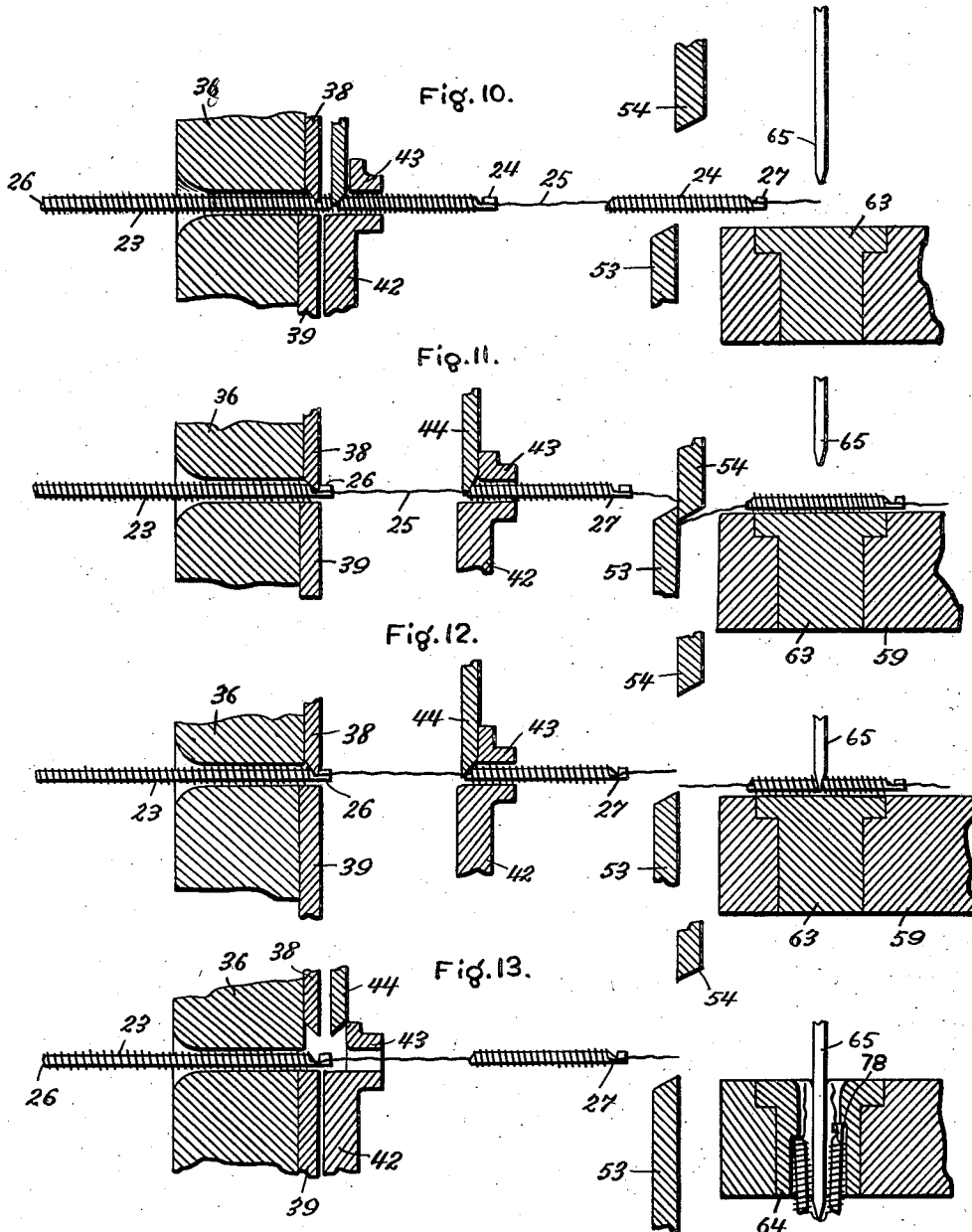
1,591,833

V. G. JARMAN

METHOD OF AND MACHINE FOR FORMING FILAMENTS

Filed Oct. 16, 1923

4 Sheets-Sheet 4



Inventor:
Vincent G. Jarman

by *Alexander S. Lane*
His Attorney

Patented July 6, 1926.

1,591,833

UNITED STATES PATENT OFFICE.

VINCENT G. JARMAN, OF BELLEVILLE, NEW JERSEY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

METHOD OF AND MACHINE FOR FORMING FILAMENTS.

Application filed October 16, 1923. Serial No. 668,934.

My invention relates to the production of coils which are either spaced apart at intervals, or bent, or both, and more particularly to the production of coiled metallic filaments for use in incandescent lamps and similar devices.

The filaments of incandescent lamps are commonly made of tungsten wire. For the reason, among others, that it is desirable to make the filament compact, it is common practice to coil the tungsten wire into coils having a diameter several times that of the wire, the turns of the coil being spaced quite closely and usually as closely as practicable. Long continuous coils of very uniform pitch and diameter may be made by coiling wire without a mandrel, or by winding the tungsten wire on a brass, iron, or bronze wire of the proper size and then dissolving the wire mandrel with acid which will not attack the tungsten. In forming continuous coils on a mandrel, it is customary to feed wire of great length through suitable machines which wind the tungsten wire in a continuous coil upon the mandrel so tightly that the mandrel wire with the tungsten wire wound on it may be handled like ordinary wire without displacing or injuring the coils of tungsten wire.

In many cases it is desirable to have a filament made up of a number of comparatively short coils spaced apart and joined by short lengths of substantially uncoiled wire. Such spaced coils made by the methods heretofore used are apt to vary in pitch.

One object of my invention is to produce a method and apparatus for producing spaced coils which are more uniform in pitch and more accurately spaced than those heretofore generally used. Another object of my invention is to provide a method and apparatus for making from a long continuous coil of uniform pitch a series of short coils of the same pitch as the long long coil, the short coils being spaced at definite distances from one another and joined by short lengths or sections of substantially uncoiled wire. Still another object is to provide a method and apparatus for quickly and automatically converting a coil of long tungsten wire into coiled lamp filaments having uncoiled or practically straight ends, the filaments being bent if desired. A further object is to provide a machine for spacing coiled filaments which is completely automatic and in which

the only attention required is to keep it supplied with filament wire wound in a continuous coil of the proper pitch.

In accordance with my invention, short coils suitable for lamp filaments and having sections of substantially straight wire at each end are made from a long continuous coil of the desired pitch and diameter by uncoiling one or more selected turns of the long coil to produce a section having a pitch so much coarser than the long coil that it becomes practically a straight section while maintaining unchanged the pitch and diameter of the remaining turns. The selected turns may be uncoiled into a section having such a coarse pitch as to be substantially straight wire in various ways, preferably by stretching them lengthwise of the coil until the wire constituting the selected turns is uncoiled and straight enough for practical purposes. The stretching may conveniently be done by moving the short coil bodily away from the long coil and thereby uncoiling and straightening out one or more turns of the long coil into substantially straight wire. During this movement those end turns of the short coil and of the long coil adjoining the turns which are straightened out are held against displacement to prevent distortion and change of pitch of either the short coil or the long one. A convenient way to hold the end turns of the coil and at the same time uncoil the selected turns is to insert one thin blade between the end turn of the short coil and the adjoining turn, and another blade parallel to the first between the end turn of the long coil and its adjoining turn, these blades extending nearly across the coils and having between them the selected turns which are to be uncoiled. The blades are now separated longitudinally of the long coil, carrying the short coil bodily away from the long coil and stretching the selected turns into a section having a pitch so coarse as to be practically straight. By uncoiling turns of the long coil in this manner at suitable points the continuous coil may be converted into filaments consisting of spaced coils joined by uncoiled sections. By cutting these uncoiled sections, there is obtained filaments of the desired lengths consisting of one or more coils and having substantially straight ends well adapted to be fastened to the leading-in wires of the lamp. The operations of stretching

the selected coils and cutting the uncoiled sections may be carried out automatically to advantage, particularly by the mechanism hereinafter described.

5 If the long continuous coil of tungsten wire of uniform pitch contains the wire mandrel on which it was wound the mandrel is notched or partly cut through at those points where one or more turns are stretched to
10 obtain the straight sections, the mandrel being broken at the notch as the turns of the coil are stretched. In this case the sharp edge of one of the blades which enter between turns of the coil cuts into the mandrel
15 deeply enough to weaken it so that it will break easily, particularly when the blades move away from each other to pull out lengthwise of the mandrel the turns of the coil between them into a practically straight
20 section.

Filaments well adapted for miniature lamps may, by my invention, be made easily and rapidly by cutting each of the straight sections at the middle, so as to obtain short
25 coils, each having straight end sections, and then bending each coil at the middle. If the mandrel is in the short coil it will be of approximately the same length as the coil, and is broken at the middle when the
30 coil is bent. The cutting of the straight sections and the bending of the coils may be done automatically if desired.

My invention may also be embodied in an automatic machine in which the continuous
35 coil is spaced into short coils with straight ends by straightening out one or more turns of the long coil at intervals, and which is particularly suitable for handling long coils wound tightly on a long mandrel wire. In
40 such a machine the mandrel wire with the tungsten wire closely coiled on it is automatically notched or weakened at a distance from its end corresponding to the length of one coil. The short piece of mandrel is
45 broken off and with the wire tightly wound on it is moved away from the remainder to stretch one or more coils of the tungsten wire out practically straight, after which the mandrel wire is fed forward automati-
50 cally a distance equal to the length of the next coil, whereupon the operation of breaking off a piece of the mandrel and pulling it away from the remainder of the mandrel is repeated to space the second coil away
55 from its end of the long mandrel wire, and so on, until all of the tungsten wire coiled on the mandrel is utilized. Where this machine is used to manufacture filaments which are bent so that the coils are either side by
60 side or adjacent each other, I provide an automatic mechanism for first cutting the straight sections between coils at the middle, and then bending the short coils at the middle, breaking or cutting the short lengths of
65 mandrel wire near the middle if necessary,

and automatically bending the coil of tungsten wire at that point so as to make a bent coil with two legs substantially side by side, with the pieces of mandrel wire still in them, and with two substantially straight ends for
70 attaching the filament to the leads.

The novel features of my invention will be pointed out with greater particularity in the accompanying specification and claims but the invention itself will best be under-
75 stood in connection with the accompanying drawings in which merely for purposes of illustration I have shown one form in which my invention may be embodied and in which
80 Fig. 1 is a top view of one form of machine constructed in accordance with my invention; Fig. 2 is a side view of the machine shown in Fig. 1; Fig. 3 is a transverse section, along the lines 3—3 of Fig. 1; Fig. 4
85 is a transverse section along the line 4—4 of Fig. 1; Fig. 5 is a transverse section along the line 5—5 of Fig. 1; Fig. 6 is a transverse section along the line 6—6 of Fig. 1; Fig. 7 is a transverse section along the line 7—7 of Fig. 1; and Fig. 8 a section along
90 the line 8—8 of Fig. 1; Fig. 9 a perspective view showing in elevation the essential parts of the machine illustrated in Fig. 1; Figs. 10, 11, 12 and 13 are diagrammatic views showing various steps of the method con-
95 stituting my invention as carried out by the machine illustrated in Fig. 1; Fig. 14 a top view of the table on which the coils are bent; Fig. 15 is an end view of part of Fig. 14; Fig. 16 a longitudinal section of Fig. 15; Fig. 17 a top view of Fig. 16 with the cover plate partly broken away, and Fig. 18 a bottom view of Fig. 16.

The machine shown in the drawings comprises a base 20 on which is mounted a drive
105 shaft 21 carrying the cams for actuating the various parts of the machine and driven by a pulley or drive wheel 22 preferably made quite heavy to act as a fly wheel. The long continuous coil of tungsten wire 23 is auto-
110 matically divided up in short coils 24 joined to each other by straight sections 25 formed by uncoiling some of the turns of the coil. The long coil is shown tightly wound on a long mandrel wire 26 from which short
115 pieces 27 carrying the short coils are broken or cut off. My invention is equally applicable to long coils with or without a mandrel or interior support, but will be described as applied to the more common form of coil
120 tightly wound on a long mandrel wire.

The long coil is wound on a spool 28 and is fed through the machine intermittently by a feed mechanism which will feed it in steps of very definite and exact length. The feed
125 mechanism shown in the drawings comprises a locking pawl 29, to prevent reverse movement of the coil, mounted adjacent a guide block 30 secured to the base 20 and in which a feed slide 31 reciprocates lengthwise of the
130

mandrel wire. On this slide and near its forward end is pivoted a feeding pawl 32, the inner end of which grips the coil and clamps it to the feed slide when the pawl is swung in a clockwise direction by the forward movement of a feed lever 33 connected to the outer end of the pawl and actuated by a feed cam 34 to have a travel considerably greater than the movement of the pawl. The extent of the swing of the pawl 32 about its pivot is controlled by an adjustable feed screw 35 mounted on the pawl. When the feed lever 33 swings the pawl a short distance in a counter clockwise direction its inner end is released from the coil and then the feed screw strikes a shoulder on the slide 31, locking the feed lever to the slide so that any further movement of the feed lever 33 moves the slide backwards. The feed lever 33 not only moves the pawl 32 to and fro on its pivot, but it also reciprocates the feed slide 31 backwards and forwards along the coil. As the coil cannot move backward because of the locking pawl 29 the distance which the feed slide 31 moves back along the coil determines the length of coil which will be fed forward on the next forward movement of the feed slide. By altering the position of the feed screw 35 the extent of feed of the coil can be altered.

The coil is delivered by the feed mechanism to a spacing device which uncoils and straightens one or more turns of the coil to make the straight sections. The distance between these sections, and therefore the length of the short coils, depends upon the extent to which the long coil is moved by the feed mechanism. The spacing device also weakens the mandrel wire, when it is present in the coil, at the points where the turns are to be uncoiled. The weakening of the mandrel wire may be accomplished in various ways, but one convenient way is to indent or notch it.

In the particular machine shown the spacing device comprises a holding means for the long coil and uncoiling means for straightening out one or more turns. The holding means comprises an upright guide 36 in which a holding head 37 is mounted to reciprocate vertically and to which a holding jaw in the form of a blade 38 is adjustably secured in such position that its lower edge cooperates with a stationary holding jaw or anvil 39. The coil is delivered by the feed mechanism between the holding blade 38 and the coil support or anvil 39. The blade is actuated by a lever 40 connected at one end to the holding head 37 and actuated at the other end by a holding cam 41. As the holding blade 38 descends into the position shown in Figs. 10, 11 and 12, it enters between adjoining turns of the coil, but even in its lowermost position its edge is further away from the anvil

39 than the diameter of the tungsten wire 23. If the mandrel wire is present the edge of the blade cuts into it a distance somewhat less than its diameter thereby making a deep notch in it which weakens it at that point, without cutting or injuring the tungsten wire coiled on the mandrel. The turns of tungsten wire on the mandrel lie so nearly parallel to the edge of the blade that even though a turn is directly below the blade the round wire is not caught and crushed by the edge of the blade, but is pushed slightly to one side along the mandrel as the blade descends. This very slight displacement of one turn of the coil is of no practical importance, but permits the blade to notch the mandrel.

The uncoiling mechanism seizes the coil near the holding blade and uncoils one or more turns of the coil immediately adjacent the mandrel wire at the notch and moves the broken off length of mandrel away from the holding blade without changing the pitch of the coil. This uncoiling is preferably done by stretching and straightening one or more of the turns of the coil while the holding blade 38 in its lowermost position grips the mandrel and also prevents movement and distortion of any of the turns of the coil behind it. In the particular machine shown the uncoiling mechanism comprises a movable stretching jaw or anvil 42 having a tubular guide tip 43 for the coil and cooperating with a stretching jaw in the form of a blade 44 mounted upon one end of a bell crank lever 45 actuated from the other end by a cam 46 on the drive shaft 21. As best shown in Figs. 10, 11 and 12 the blade 44 as it approaches the coil support or anvil 42 enters the coil transversely by passing between adjoining turns of the coil, until the holding blade 38 and the stretching blade 44 are both embedded in the coil. These blades are now parallel and have between them one or more turns of the coil which are later uncoiled and stretched out straight to form the uncoiled connection between adjacent coils. The distance between the blades and the pitch of the coil determine the number of turns which are uncoiled, and therefore the length of the straight section produced from them.

The stretching anvil 42 and stretching blade 44 are mounted upon and move bodily with a stretching head 47 which reciprocates longitudinally of the coil. The anvil is provided with guide rods 48, one of which is surrounded by a coiled spring 49 which moves the head along the coil away from the holding blade 38 to stretch the turns of the coil which are to be uncoiled. To bring the stretching head back against the pressure of the springs 49 there is provided a cam follower 50 adjustably mounted on the stretching head by means of an adjusting

clamp 51 in a position to engage a retracting cam 52 mounted on the drive shaft 21. The retracting cam is a side cam so proportioned that during part of its revolution it holds the stretching head in its retracted position close to the holding blade 38 as shown in Figs. 1 and 10, while during the remainder of its revolution it permits the stretching head to move under the influence of the springs 49 into the position shown in Figs. 9, 11 and 12, thereby stretching out and straightening the turns of the coil between the blades 38 and 44.

The mechanism thus far described will produce from a long continuous coil shorter coils of a length determined by the adjustment of the feed screw 35 of the feeding mechanism and spaced apart a distance equal to the travel of the stretching head 47, these short coils being joined by substantially straight sections produced by stretching one or more turns of the long coil until the wire is substantially straight. This operation does not in any way alter or disturb the pitch of the coil, because the holding blade 38 and stretching blade 44 prevent any movement of the turns adjoining the turns which are straightened by stretching, and support the end turns of the short coil and of the long coil which would alter the pitch of the coil.

The travel of the holding blade 38 is so adjusted that when the mandrel wire is in the coil the edge of the blade will sink part way into the mandrel wire, as shown in Figs. 10, 11 and 12, and will hold it against longitudinal movement and also prevent the long coil being pulled off the mandrel or its pitch changed during the stretching of the turns which are to be straightened. The stretching blade 44 travels a little further than the holding blade and so nearly severs the mandrel wire that, as indicated in Fig. 10, the mandrel wire breaks opposite the blade. Both blades remain in the relation to their cooperating anvils shown in Figs. 10, 11 and 12 during the straightening of the turns of the coil. As the stretching anvil moves away from the holding blade it carries with it the short broken off piece of mandrel wire on which is the short coil, and pulls those turns of the long coil which are between the blades 38 and 44 off the projecting end of the long mandrel wire and straightens them out as indicated in Fig. 11. The blade 44 supports the end turn of the short coil, and therefore, the pitch of the short coil on the short piece of mandrel wire is preserved. The result is spaced coils in which each coil is wound upon a length of mandrel substantially equal to the length of the coil and when these pieces of mandrel are removed the result is a filament made up of coils spaced apart the desired distance.

For producing coiled filaments which have

straight ends for attaching the filament to the lead wires I may cut the straight portions of the tungsten wire at the middle, and thereby obtain a coil having two straight ends. In the machine illustrated the cutting is done automatically by means of a shearing mechanism which comprises a stationary blade 53 and a cooperating movable blade 54 preferably in the form of a disc which may be turned to present a fresh cutting edge. The movable blade is mounted on one end of a shearing arm 55, the other end of which is connected through a link 56 to a shearing lever 57 actuated by a shearing cam 58 on the drive shaft 21. As best shown in Figs. 11, 12 and 13, the shearing blades are positioned to cut the straight portion of the tungsten wire at about the middle when the stretching head 47 is in its forward position.

For some uses the coil with straight ends should be bent to make a filament consisting essentially of two coils side by side. By my invention such a filament can easily be made by automatic bending mechanism to which the coils are delivered from the spacing mechanism. The particular form of bending mechanism shown in the drawings comprise a rotary table 59 intermittently rotated by a ratchet 60 secured to the table and actuated by a reciprocating ratchet bar 61 driven by a ratchet cam 62. The table has near its periphery a ring of cutting blocks 63 and bending dies 64 mounted at the same radial distance from the center of the table and arranged alternately. A bending punch 65 with a sharp lower edge cooperates with a cutting block 63 to cut or break the short piece of mandrel wire 27 which is automatically placed on the cutting block 63 during the operation of the machine and also cooperates with the bending dies 64 to bend and shape the short coil 24. The bending punch is mounted on a reciprocating bar 66 actuated through a lever 67 from a cam 68 shaped, as best shown in Fig. 7, to cause the bending punch 65 to make two strokes of different amplitude for each revolution of the drive shaft 21. The mechanism is so timed that during each revolution of the drive shaft 21 the table is moved twice, first to bring a cutting block 63 and, second to bring a bending die 64 into registry with the bending punch 65. While the table is in the first position the bending punch makes its first stroke and in cooperation with the cutter block, as best shown in Fig. 12, cuts or breaks the short piece 27 of the mandrel wire practically at the middle. It then rises far enough to release the coil and mandrel wire until the bending die comes into registry with the punch, whereupon the punch makes its second stroke and descends far enough, as best shown in Fig. 13, to thrust the short coil 24 with the pieces of mandrel wire in it, into the bending die

and thereby bend it up into a filament of the desired shape, usually a V or U shaped filament with straight ends.

To hold the short coil in place on the table during the bending operation I provide a coil holder, such as a holding plate 69 which rests upon the table and has a recess or notch for holding the coil in proper relation to the bending punch. In the particular arrangement illustrated a curved holding plate is secured at one end to the frame of the machine, with the free end resting on the table immediately beneath the bending punch 65. This free end is provided with a slot 70 extending radially of the table and proportioned to hold the coil under the bending punch 65, as best shown in Fig. 16. The corners of the slot 70 are rounded and the entrance is funnel-shaped so that the coil can be thrust into the slot automatically without catching on the sides. A transverse punch slot 71 permits the bending punch 65 to move downward across the coil slot 70 and into the bending die 64. The coil is thrust into the slot 70 while a cutter block 63 is beneath the slot and in registry with the bending punch 65. After the punch on its first stroke has cut or broken the short piece of mandrel wire the table rotates one step to bring the bending die underneath the slot and into registry with the bending punch, and during this movement of the table the coil is held in place by the walls of the slot 70. The end of the holding plate, as best shown in Fig. 18, is cut away on the bottom side on one side of the slot 70 to form a recess 72 through which pieces of a broken coil can be swept out with the movement of the table and thus discharged from the machine. The holding plate is provided with lugs 73 and 74 on each side of the punch slot 71, and so spaced that an unbroken coil is longer than the distance between the two lugs and therefore these lugs will hold the coil against movement with the table. Pieces of broken coils are ejected from the slot 70 through the recess 72 and out over the surface of the table by a jet of compressed air introduced through a compressed air pipe 75. The slot 70 is covered by a cover plate 76 which, as best shown in Figs. 15 and 16, is cut away over the entrance to the slot 70 to make a sort of funnel shape opening into the slot and is also cut away immediately back of the bending punch slot to form a recess 77 to receive the end of the coil as the coil is being bent by being forced into the bending die 64 by the bending punch 65.

In some cases the bent filament has a tendency to cling to the bending punch 65 and in order to strip it from the punch I may provide the bending die 64 with stripping shoulders 78, as best shown in Fig. 16. These

shoulders will catch the ends of the coil as the bending punch moves upward out of the bending die, and will in that way, strip the coil from the punch.

The bent filament is springy enough to stick in the bending die 64 until the table brings the die into registry with a reciprocating ejector pin 79 actuated through a pin 80 on the lever 67. The ejector forces the shaped filament out of the die into a trough 81. If desired the shaped filaments projecting from the bending die may be heated by means of a burner 82, to anneal the wire and render it less resilient. The bending dies are further cleaned by a jet of compressed air from a nozzle 83.

The operation of my machine will be clear from the foregoing description, but may be summarized as follows:

The long coil 23 is fed forward a fixed distance so that a portion of it projects from the holding device whereupon the holding blade 38 descends and enters between two adjoining turns of the coil and sinks into the mandrel wire, if it is present, far enough to firmly clamp the mandrel wire to the holding anvil 39 and at the same time, hold the end turn of the long coil of wire against displacement longitudinally of the coil. At the same time the stretching blade enters between two adjoining turns parallel to and a short distance from the holding blade 38 moving far enough to cut in the mandrel wire a notch so deep that the mandrel wire usually breaks at this point. The holding blade and stretching blade are now both embedded in the coil and have between them one or more turns of the coil. The stretching blade and anvil are now moved bodily lengthwise of the coil by the coil spring 49, this movement being controlled by the stretching cam and thereby the one or more turns between the holding blade and the stretching blade are pulled out or stretched until they are practically straight and form the straight section 25. If the short piece 27 of the mandrel was not broken off when the stretching blade first gripped the mandrel it is broken at the beginning of the stretching movement during which the one or more turns which form the straight section 25 are pulled off of the projecting end of the long mandrel wire 26. During this stretching the end turns of the long coil 23 and of the short coil 24 are so supported and held by the holding blade 38 and the stretching blade that there is no distortion or change in pitch of the coils.

After the straight section 25 is formed the blades open, the stretching device returns to its initial position shown in Fig. 13 and thereupon the operation above described is repeated with the result that the long continuous coil is converted into a filament con-

sisting of short coils spaced apart a definite distance and joined by substantially straight sections.

As the coils are formed and spaced they are fed forward by the feeding mechanism into position in the slot 70 underneath the bending punch 65. The tungsten wire forming the straight section 25 is stiff enough to enable the feed mechanism for the long coil to push the short coils into place in the slot 70. After the short coil is in position the shears cut the straight section at about the middle, after which the bending punch breaks the short length 27 of mandrel wire at the middle and then bends the short coil into shape by thrusting it into the bending die 64.

My invention may be embodied in other forms than that described and I do not wish to be restricted to the particular form of apparatus disclosed.

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

1. The method of converting a long continuous coil of wire into shorter coils of the same diameter and pitch and connected by substantially straight sections which consists in producing said straight sections at definitely spaced points of said long coil by uncoiling one or more turns of said long coil while holding the adjoining turns to prevent their distortion.

2. The method of converting a long continuous coil of wire into shorter coils of the same diameter and pitch and connected by sections of relatively coarser pitch which consists in producing said sections by stretching at points spaced along the coil one or more turns of said long coil lengthwise while supporting the adjoining turns to prevent their distortion.

3. The method of converting a long continuous coil of wire into shorter coils of the same diameter and pitch and connected by sections of relatively coarser pitch which consists in producing at points definitely spaced along said long coil relative movement of adjacent portions of said long coil to uncoil at each point into a connecting section one or more turns between said adjacent portions and simultaneously holding said adjacent portions to prevent change in their pitch during said relative movement.

4. The method of converting a long continuous coil of wire into shorter coils of the same diameter and pitch and connected by substantially uncoiled sections which consists in embedding two blades in said coil transversely thereof and between turns of said coil with one or more free turns between said blades, and moving said blades apart to stretch the turns between them into a substantially uncoiled section.

5. The method of converting a long continuous coil of wire into shorter coils of the

same diameter and pitch and connected by sections of relatively coarser pitch which consists in gripping a long coil at two adjacent points to leave one or more turns between said points free, and producing relative movement between said adjacent portions while gripped and held against distortion or change in pitch and thereby substantially uncoiling the free turns between said points.

6. The method of making a filament composed of short coils spaced apart and joined by uncoiled sections which consists in uncoiling one or more turns of a long continuous coil at selected points to make said uncoiled sections, and cutting some of said uncoiled sections near the middle to obtain uncoiled ends.

7. The method of producing coils with straight end sections which consists in uncoiling one or more turns of a long continuous coil to produce shorter coils joined by straight sections and cutting each straight section near the middle to obtain coils with straight end sections.

8. The method of producing shaped coiled filaments with uncoiled end sections of relatively coarser pitch which consists in uncoiling one or more turns of a long continuous coil to produce shorter coils joined by uncoiled sections, cutting each uncoiled section near the middle to separate a short coil from the long coil, and bending the separated short coil into shape.

9. In a machine of the class described, the combination of uncoiling mechanism for producing a relative movement between adjacent portions of a long continuous coil to uncoil one or more turns into a section of relatively coarser pitch, feed mechanism for feeding a coil to said uncoiling mechanism, and common actuating means for operating said feed mechanism and said uncoiling mechanism in sequence.

10. In a machine of the character described, the combination with feed mechanism for a long continuous coil, of uncoiling mechanism comprising holding means for gripping said coil at two selected points separated from each other by one or more free turns of the coil, and means for actuating said holding means to produce relative movement of said points on said coil to uncoil said free turns into a substantially straight section, and common actuating means for actuating said feed mechanism and said uncoiling mechanism in synchronism.

11. In a machine of the character described the combination with uncoiling mechanism for automatically uncoiling into a straight section one or more turns of a long continuous coil, of feed mechanism for feeding said coil longitudinally step by step comprising a reciprocating feed block

mounted to reciprocate toward and away from said uncoiling mechanism, means on said block for carrying said long coil forward with said block during its forward movement toward said uncoiling mechanism, means for preventing backward movement of said coil during backward movement of said block, and common actuating means for actuating said feed mechanism and said uncoiling mechanism in synchronism.

12. In a machine of the character described, the combination with uncoiling mechanism for automatically uncoiling into a straight section one or more turns of a long continuous coil, of feed mechanism for said coil comprising a reciprocating block, a pawl pivoted on said block to cause one end to cooperate with said block to clamp said coil to said block during forward movement thereof when said pawl is swung in one direction, means for locking said pawl to said block when swung far enough in the other direction to release the coil and impart backward movement to said block, actuating means for swinging said pawl to and fro, and a locking pawl mounted in the line of reciprocation of said block to prevent reverse movement of said coil during the backward movement of said block.

13. In a machine of the character described an uncoiling mechanism for straightening turns of a long continuous coil of wire, comprising two pairs of cooperating holding members mounted to open and close, one member of each of said pairs having a thin blade, means for closing each pair of holding members until the distance between them is less than the diameter of the long coil but greater than the diameter of the wire of said coil, and means for moving said holding members away from each other while they are in closed position.

14. In a machine of the character described, an uncoiling mechanism, comprising a holding device for engaging and supporting a turn of a long continuous coil of wire, a stretching device for engaging and supporting another turn of said coil at an adjacent point to leave one or more free unsupported turns between said holding device and said stretching device, and means for producing relative movement between said devices to stretch out and substantially straighten the free turns between said devices.

15. In a machine of the character described an uncoiling mechanism for a long continuous coil comprising relatively movable coil supports, a cooperating holding blade movable toward one of said supports to enter between adjoining turns of a coil resting on said support and thereby prevent longitudinal movement of the coil, a stretching blade movable toward the other support to enter between other turns of the coil at

an adjacent point and leave between said blades one or more free turns of the coil, and means for moving one support with its cooperating blade away from the other longitudinally of the coil while both blades are between turns of the coil and thereby stretching the free turns between said blades into a substantially straight section.

16. In a machine of the character described, an uncoiling mechanism comprising a pair of cooperating holding jaws, one formed as a holding blade with its edge proportioned to enter between adjoining turns of a long continuous coil, a stretching head mounted to move toward and away from said holding blade, a pair of stretching jaws mounted on said head, one of said jaws being a stretching blade proportioned to enter between turns of said long coil, means for actuating said holding blade and said stretching blade to bring their edges into proximity to their cooperating jaws, and means for moving said stretching head away from said holding blade while both of said blades are held in proximity to their cooperating jaws.

17. In a machine of the character described for uncoiling selected turns of a long continuous coil, the combination with a feed mechanism for said coil, of an uncoiling mechanism comprising two pairs of holding jaws, one jaw of each pair being a thin blade, jaw actuating means for simultaneously opening both pairs of jaws wide enough to permit the long coil to pass between them and for simultaneously closing both pairs of jaws to bring the blade jaws of each pair between adjacent turns of the long coil, a movable support for one pair of said jaws movable to carry said pair bodily toward and away from the other pair, and common actuating means for actuating said feed mechanism, said jaw actuating means and said movable support in sequence to feed the long coil into said open jaws to close both pairs of jaws and move said support to separate said pairs of jaws while both are closed, and to open both pairs of jaws and return said support to initial position while said jaws are open.

18. In a machine of the character described for uncoiling selected turns of a long continuous coil, an uncoiling mechanism comprising a stationary pair of jaws for gripping and holding a turn of said long coil, a sliding block mounted to move toward and away from said stationary jaws, a pair of jaws mounted on and bodily movable with said block to grip another turn of the long coil, jaw actuating means for simultaneously opening both pairs of jaws to permit the long coil to be placed in position in said jaws and for simultaneously closing said jaws to grip turns of said coil with one or more free turns

between said pairs of jaws, and means for moving said block away from the stationary pair of jaws to straighten said free turns.

19. In a machine of the character described for uncoiling selected turns of a long continuous coil, an uncoiling mechanism comprising two pairs of jaws for holding adjacent turns of the long continuous coil, said jaws being mounted to be bodily movable toward and away from each other, means for yieldingly moving said pairs of jaws bodily away from each other, control means for permitting said pairs of jaws to move away from each other and for positively moving them bodily toward each other, and common actuating mechanism for closing and opening said jaws and for positively moving said pairs of jaws toward each other.

20. In a machine of the character described for uncoiling certain turns of a long continuous coil, an uncoiling mechanism comprising a pair of jaws for holding a turn of said coil, a sliding block mounted to reciprocate toward and away from said stationary jaws, a spring tending to move said block away from said stationary jaws, a second pair of jaws mounted on said block to hold a turn of the long coil, a cam for positively moving said block against the tension of said spring to bring said two pairs of jaws into proximity, and common actuating means for actuating said jaws and said cam to close both pairs of jaws while in proximity and to permit said spring to move said block while said jaws are closed.

21. In a machine of the character described the combination of an uncoiling mechanism for automatically uncoiling one or more turns of a long continuous coil to render the wire of said turns substantially straight, a shearing mechanism adjacent said coiling mechanism, a filament shaper adjacent said shearing mechanism and feed mechanism constructed to feed a long continuous coil of wire intermittently through said uncoiling mechanism and thereby bring an uncoiled section of said long coil into registry with said shearing mechanism and a short coil adjoining said straight section into said shaping mechanism, and common actuating means for actuating said mechanisms in synchronism.

22. In a machine of the character described a filament shaping mechanism comprising a rotatable table, a cutting block and a bending die mounted side by side on said table, a bending punch mounted to reciprocate perpendicularly to said table, a holder on said table to hold a coil stationary and in registry with said punch during movement of said table, and common actuating mechanism for moving said table step by

step to bring said cutting block and said die successively into registry with said punch and to move said punch into operative relation to said cutting block and said bending die successively.

23. In a machine of the character described, a filament shaping device comprising a bending punch mounted to reciprocate, a movable carrier having a cutting block and a bending die, means for moving said carrier to bring said block and said die in succession into registry with said punch, and common actuating means for said carrier and said punch for causing said punch first to approach said cutting block to cooperate therewith, and secondly to enter the said bending die.

24. In a machine of the character described a filament shaping mechanism comprising a rotatable table having cutting blocks and shaping dies arranged alternately in a ring concentric with the axis of the table, a punch mounted to reciprocate perpendicularly to said table in alinement with said blocks and dies, table actuating means for giving said table a step by step movement to bring each block and die in succession into registry with said punch, and punch actuating mechanism connected to said table actuating mechanism and constructed to impart to said punch a short stroke to bring it into operative relation to each cutting block and a longer stroke to bring it into operative relation to each bending die.

25. In a machine of the character described, a filament shaping mechanism comprising a movable carrier having cutting blocks and bending dies, a punch mounted to reciprocate and to cooperate with each cutting block and each bending die in succession, and a stationary holder adjacent said table and in registry with said punch to hold the filament in place in registry with the punch during the movement of the table.

26. In a machine of the character described, a filament shaping mechanism comprising a reciprocating punch, a table mounted to rotate transversely of the direction of movement of said punch and having cutting blocks and bending dies arranged alternately to come in succession into registry with said punch as said table rotates, a stationary coil holder resting on said table underneath said punch and provided with a radial slot to receive and hold a coil with its middle point in registry with said punch during the rotation of the table, and actuating means for moving said table step by step and for reciprocating said punch.

In witness whereof, I have hereunto set my hand this 12th day of October, 1923.

VINCENT G. JARMAN.