Aug. 4, 1931. F. W. WALTON 1,816,880

MANDRELLESS MULTIPLE DIE COIL WINDING MACHINE

Filed Sept. 30, 1927 3 Sheets-Sheet 1

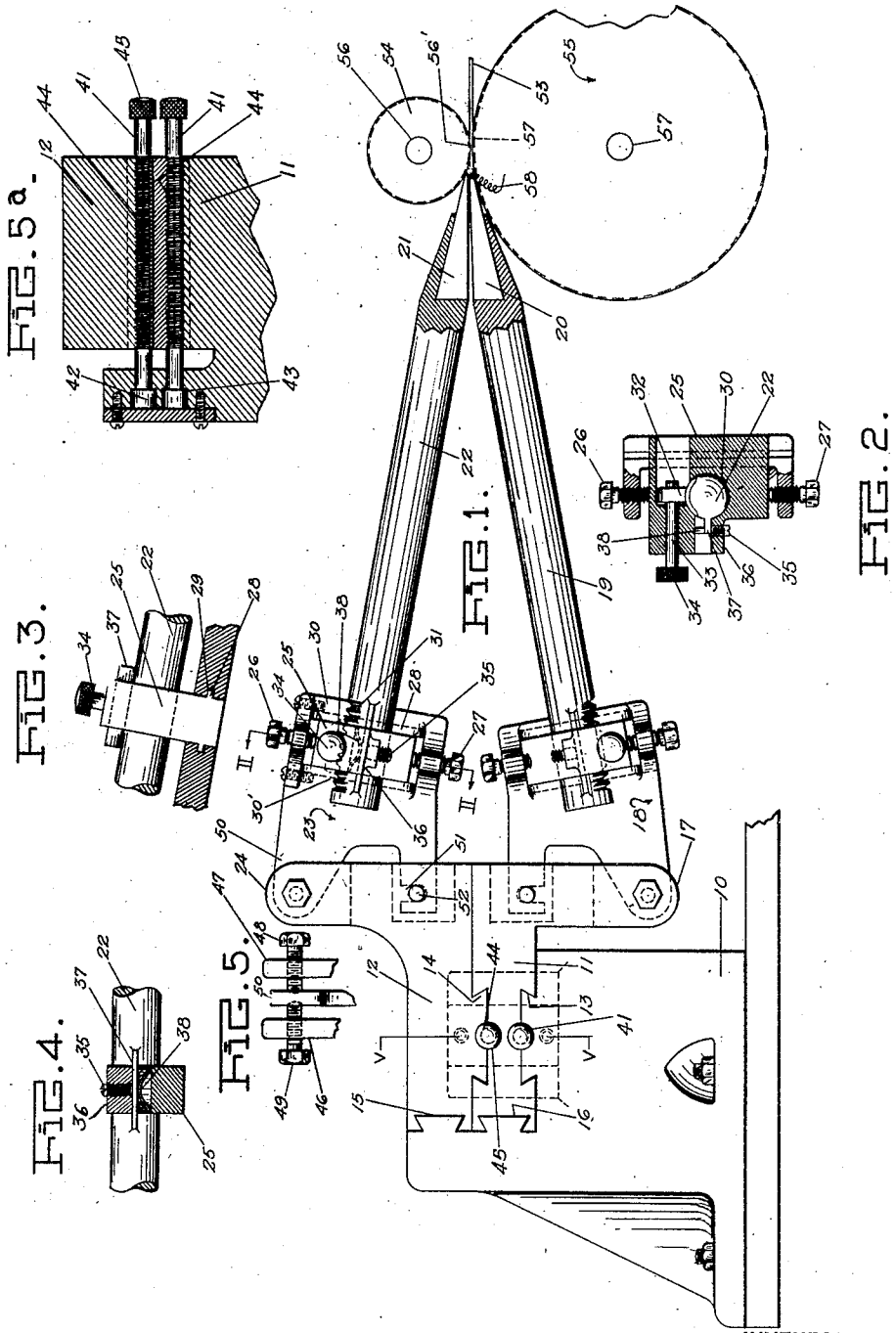


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 5a.

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MANDRELLESS MULTIPLE DIE COIL WINDING MACHINE

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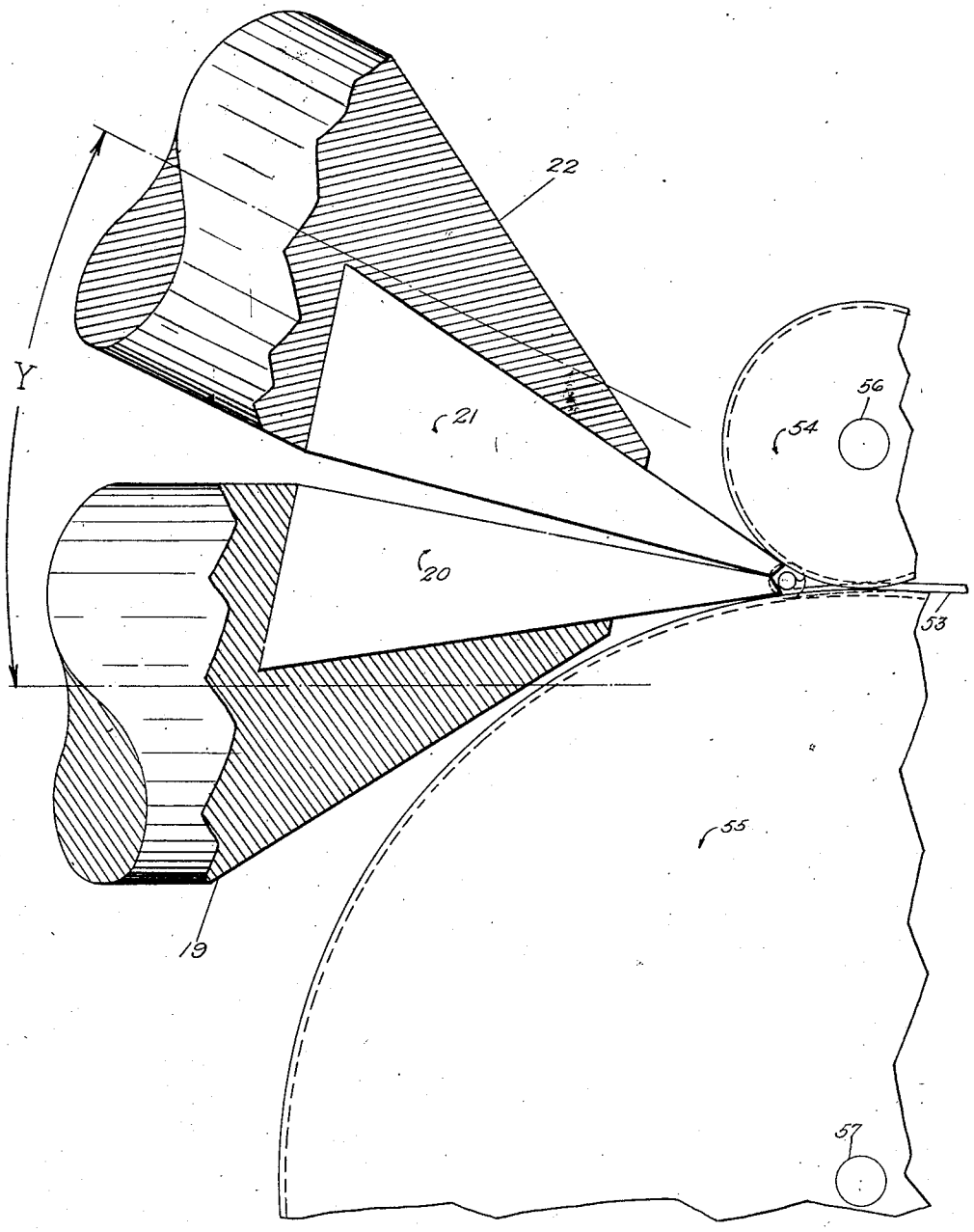


FIG. 6.

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MANDRELLESS MULTIPLE DIE COIL WINDING MACHINE

Filed Sept. 30, 1927 3 Sheets-Sheet 3

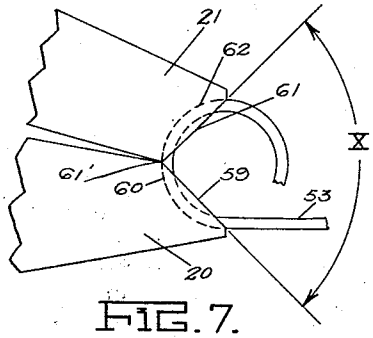


FIG. 7.

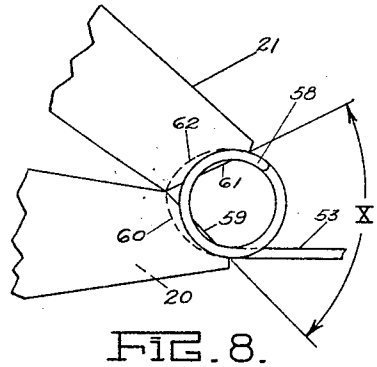


FIG. 8.

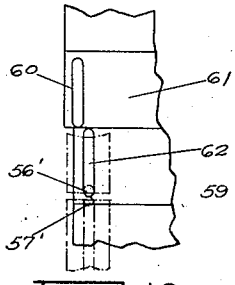


FIG. 10.

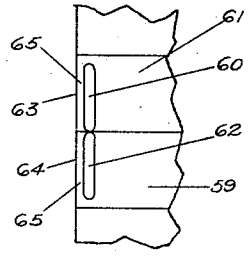


FIG. 9.

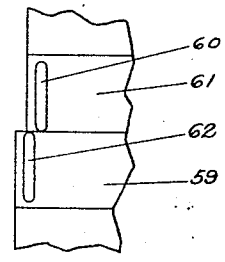


FIG. 11.

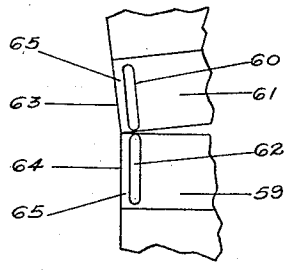


FIG. 12.

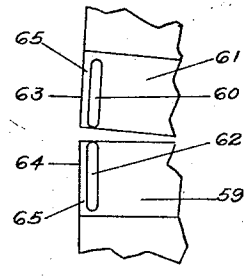
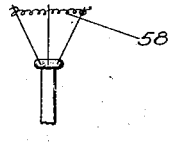


FIG. 13.

FIG. 14.



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UNITED STATES PATENT OFFICE

FRANK W. WALTON, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTINGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA

MANDRELLESS MULTIPLE DIE COIL WINDING MACHINE

Application filed September 30, 1927. Serial No. 223,043.

This invention relates to the manufacture of helically wound coils and particularly to the production of coiled filamentary bodies as employed as light giving elements in incandescent electric lamps.

Certain types of incandescent electric lamps employ what is termed a concentrated light source, heretofore produced in various ways as by winding a fine wire upon a mandrel into a continuous helix of indefinite length and then cutting the wound mandrel into sections of given lengths, depending upon the type of lamp or the wattage desired in the coiled section to be employed as the light source or what is commonly known as the filament. It has also been proposed to wind a filament wire in the form of a helix in the absence of a mandrel as in the manner shown and described in co-pending application 121,156 filed July 8, 1926 (Patent No. 1,670,499, dated May 22, 1928) and assigned to the same assignee as is the present invention.

Certain difficulties attend the production of lamp filaments since given conditions must be carefully observed and strictly adhered to in order to produce filaments properly proportioned and dimensioned. The length of the selected diameter filament contained in a light source must be exact so that the proper resistance will be obtained for a given wattage lamp, which length must be contained in a helix of a given number of turns, the pitch of the helix must be maintained uniform and the outside diameter of the helix held constant.

The winding of a filament on a mandrel necessitated the subsequent removal of the mandrel before the filament could be used in the lamp. Usually the mandrel is made of brass or iron and removed by immersing the mandrel wound coils in an acid such as hydrochloric acid until the mandrel dissolves. This process is both laborious and time consuming and adds materially to the cost of the production of coiled filaments. At the same time, there is a possibility of the acid treatment harming the filament material. Various other difficulties arise in connection with the mandrel wound filament, such as the consideration which must be given to the allowance for stretching during the winding operation and the difficulty in cutting the coiled sections of uniform lengths.

The above difficulties are overcome by employing the machine as shown in the above mentioned co-pending application in which no mandrel is employed. This machine employs a die having a cavity into which the wire is driven and from which it issues in the form of a helix. Inasmuch as various types of lamps require filaments of different specific diameters, pitch and length, means are provided for varying the relation of the die to the path of movement of the wire so as to attain the necessary variations in the dimensions of the coils produced.

The present invention aims to facilitate the production of coiled filaments of various dimensions in the absence of a mandrel and to make it possible to more easily change the diameter, pitch and coil spacing of a helix during the winding operation. In accomplishing the above, a machine is employed in which a multiple or compound coil bending die is provided. Whereas the hereinbefore mentioned mandrelless coil winding machine employed a single die in the form of a wear resisting member having a cavity, the present invention employs a pair of such dies, each having a cavity and so arranged that the combined cavities constitute a coil winding surface. The cavities are formed in die blocks in such positions that the edges of the cavities constitute a lip over which the issuing wire traverses into a series of convolutions. By this arrangement the dies may be set to bend a wire into a helix of a particular determined diameter and pitch. When thus arranged, means are provided whereby the relative positions of the respective members of the composite die may be changed and the diameter and pitch of the issuing convolutions may be accordingly varied.

By reason of this arrangement the necessity for readjusting the entire machine or a number of the parts thereto, as is necessary when employing a single die, is avoided. The compound die of the present invention

is so mounted as to be conveniently adjusted in all the necessary directions for attaining the required variations in the dimensions of the helix produced.

The invention will be more clearly understood by reference to the accompanying drawing in which:

Fig. 1 is a side elevational view illustrating the present invention, portions being broken away to more clearly show the die-members;

Fig. 2 is a sectional view taken substantially on line II—II in Fig. 1;

Fig. 3 is a detailed view of a portion of a rod or die holder and shows the same disposed in a slidable member;

Fig. 4 is a detailed view showing means for causing a rotary adjustment of a die rod;

Fig. 5 is a detailed view of the upper end of the frame work of the machine and shows the adjustability of a holder for the die rod;

Fig. 5ª is a sectional view of a portion of the machine taken on line V—V in Fig. 1;

Fig. 6 is an enlarged view of the holder in section showing the relation of the dies to wire driving members;

Figs. 7 to 13 are enlarged fragmentary views showing the compound die and their various relative positions for the production of convolutions of different dimensions; and,

Fig. 14 shows a portion of a lamp mount having a filament of the character produced by a machine constructed in accordance with the present invention.

Although the present device is applicable for the winding of coils of various diameters, it is shown and described for the manufacture of helical filaments as employed in electric incandescent lamps.

A machine constructed in accordance with the present invention may comprise a base casting or support 10 provided with a pair of lateral or horizontal slide members 11 and 12. The member 11 may be provided with a dove-tailed groove 13 for slidable engagement with the casting 10 and with an opposite similar groove 14 for slidable engagement with the member 12, thus the slide members are held in precise relation. For the purpose of a more accurate alignment, the members 11 and 12 may be provided with dove-tailed grooves 15 and 16 for engagement with the casting 10.

The member 11 may be provided with an extension 17 in which a bracket 18 carrying a die rod 19 is mounted. The projecting end of the die rod is provided with a die 20 of wear resisting material such, for example, as a diamond, sapphire or highly hardened steel. A companion die 21 is mounted in a die rod 22 held in a bracket 23 carried by an extension 24 of the member 12. The die rods and mechanism for holding the same are of similar construction and a description of one will answer for both.

Considering the die rod 22 therefore, the same is held in a block 25 positioned between oppositely disposed set screws 26 and 27. The block 25 may be provided with tongues 28 disposed in grooves 29 in portions 30 and 30′ of the bracket 23. One end of the die rod extends through an aperture in the block 25 and is provided with a rack 31. Within the block and suitably positioned so as to mesh with the rack 31 is a pinion 32 having a shaft 33 journaled in the block and provided with a thumb-nut 34 to permit a rotation of the pinion to cause an adjustment of the die rod along its longitudinal axis. A tortional or rotary movement of the rod about its longitudinal axis may be had by means of a set screw 35 extending through a threaded aperture in an extension 36 on the block 25 (see Fig. 4). The die rod is provided with a fin 37 arranged to be engaged by the set screw 35 and a spring-member 38 is provided for maintaining the said pin against said screw. It will be obvious that a rotation of the set screw 35 will cause a rotary movement of the die rod, thus adjusting the die at the exposed end thereof.

From the foregoing, it will be evident that the die rods may be moved bodily in a vertical plane and that they may also be rotated about their longitudinal axes.

In order to change the relative positions of the dies in horizontal planes, the slide members 11 and 12 are provided with threaded rods 41 as illustrated in Fig. 5ª. These rods may be rotatable and held from longitudinal movement by heads 42 in sockets 43 at one end of the casting 10 and offset therefrom. Each slide may have a threaded groove 44 to engage with the rods 41. These rods may project from the slides and be provided with thumb-nuts 45. By this construction, a thumb-nut 45 may be rotated, thereby causing a movement of a slide member. If the upper rod 41 is rotated, the threaded groove 44 will cause the slide 12 to move laterally while the slide 11 remains fixed, since there is no engagement between the upper rod 41 and the slide 11. The same is true when a rotation of the lower rod 41 is effected, namely, the threaded groove 44 in the slide 11 causes a lateral movement thereof, inasmuch as the rod 41 of the slide 12 holds the same in a fixed position. The required movement of either of the slides 11 or 12 is very slight, as only a minute movement of the die rods is necessary to change the character of the coil being wound.

For the purpose of obtaining a slight outward movement of the brackets 18 and 23, each of the extensions 17 and 24 thereof is constructed in the form of a U-shaped member having arms 46 and 47 (see Fig. 5) and set screws 48 and 49. An end 50 of the

bracket 23 is disposed between the set screws while the opposite end of the bracket is provided with a slot 51 which engages a transverse pin 52. A movement of either of the set screws 48 or 49 will permit a slight sidewise movement of the brackets 23 or 18, thus effecting an adjustment in the position of the dies 20 and 21. The set screws 48 and 49 also serve to hold the brackets against lost motion or vibration.

When the dies are held in their operative relation, a wire 53 may be fed thereto by means of force rollers 54 and 55. These rollers may be mounted on shaft 56 and 57 and driven by suitable connection to a motor or other source of power (not shown). The rollers 54 and 55 are provided with circumferential grooves 56′ and 57′, the combined diameters of the grooves being slightly less than the diameter of the wire being used so that the rollers frictionally grip the same. These rollers drive the wire into the die cavities. The cavities of the dies, therefore, must be aligned with the grooves of the rollers so that the die will properly receive the wire. Ordinarily when setting up a cavity die with respect to the force rollers, difficulty is encountered in properly positioning the die to receive the wire. In the present construction, however, the dies may be easily adjusted so that the lower die 20 may be positioned so that its cavity receives the wire from the rollers and the upper die 21 may be adjusted to vary the pitch of the convolutions issuing from the dies.

The wire 53 may be moved through a substantially rectilinear path and after being engaged by the die cavity issues from the dies in the form of a helix 58. The dies may be made as separate units and fastened to the ends of die rods as illustrated in Fig. 1 by brazing or in any suitable manner. It is obvious, however, that if desirable the rod ends may be of hardened material such as steel and provided with the necessary complementary cavities to cooperate in functioning as a coil bending die.

The construction of the dies 20 and 21 is more clearly shown in Figs. 8 to 13. It will be noted that the die 20 is provided with a bevel face 59 and with an arcuate cavity 60 and that the die 21 is provided with a bevel face 61 and an arcuate cavity 62. The faces 59 and 61 are arranged with their edges 61′ in contact so that the inclined surfaces converge toward a common point of contact. By this arrangement, the several arcuate shape notches constitute a complete die cavity and it is preferable that each arcuate cavity have a radius substantially the same as the mean outside radius of the various dimension coils to be made.

The dies are secured as heretofore set forth in the ends of the rods which can be adjusted vertically in order to change the degree of the angle X as illustrated in Figs. 7 and 8. It will be appreciated that the larger the angle between the two inclined die surfaces, the larger the diameter of the coil produced, and obviously the reverse condition will follow. As has been set forth, an adjustment of the die rods 19 and 22 may be had and a variation in the degree of their angle is indicated in Fig. 6 by the arc Y. This results in a change in the degree of the angle X and may be readily effected by the adjusting mechanism provided.

By reference to Fig. 9 it will be noted that the cavities 60 and 62 are disposed adjacent to edges 63 and 64 respectively of the die faces 59 and 61. This arrangement provides each die with a lip or spacer edge 65. In the production of a coiled filamentary body, this edge is substantially in the form of a knife blade, it being appreciated that the drawings illustrating the same are on a greatly enlarged scale. When the dies are in position as shown in Fig. 9 the end of the wire passing into and out from the slots 60 and 62 is guided over the lip or edges 65 as shown in Fig. 8 so that each successive convolution is spaced by reason of the said edges, thus determining the pitch of the coil produced. As shown in Fig. 10, the cavity 62 may readily be aligned with the grooves 56′ and 57′ of the force rollers which are indicated in dotted lines, thus making it possible to quickly and conveniently set up the machine for a coil winding operation.

When it is desirable to vary the pitch of the helix being formed, the die rods may be adjusted by a manipulation of the control elements such as the thumb-nut 45 which actuates the threaded rod 41, thus causing a relative movement between the slots 60 and 62 as, for example, to position them as shown in Fig. 10 or in Fig. 11.

A further adjustment of the dies may be had to vary the pitch of the coil by a different adjustment, for example, if a coil of large pitch is desirable, the die may be slightly tipped by a tortional movement of the die rod through a manipulation of the set screw 35, thus bringing one die cavity in angular and close relation to the other as shown in Fig. 12. If a larger diameter coil with close spacing is desired, the die rod may be moved so as to separate the die cavities and hold them in angular relation as shown in Fig. 13.

By reason of the above construction, a coiled filament may be wound of any desired pitch and diameter by a mere adjustment of the mechanism which controls the die. The adjustments provided are sufficient to meet all conditions as may be necessary to obtain exact operating conditions and the present machine has flexbility to meet the demands of the winding of filaments in accordance with given ratings, namely, data which governs the

diameter, pitch etc., of a filament for lamps of different wattages.

Another advantage of the present invention is derived from the fact that when using a diamond or other hard material die the operation of grinding the cavities is greatly facilitated. Ordinarily when grinding a diamond die, for example, extreme care and a long time period is required to obtain the necessary depth of cavity. Furthermore, it is difficult to grind the cavity to the depth required and at the same time preserve the necessary lip or spacing edge at the side of the cavity. In the present invention, the use of the compound die makes it possible to utilize a comparatively shallow cavity, thereby eliminating a greater portion of the lapping time and consequently reducing the cost of production.

Although a preferred embodiment of the invention is shown and described herein, it is to be understood that modifications may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A machine for bending a wire into helical form comprising means for driving a wire, a plurality of die-members, each die having a cavity positioned to constitute a continuous cavity to engage the driven wire to bend the same into a series of convolutions, a die rod extending from each die member and means at the ends of said die rods for changing the relative positions of said die members.

2. A machine for bending a wire into helical form comprising wire driving means for moving a wire through a given path, a compound die each member of said die having a cavity, said members being positioned to arrange the cavities to constitute a continuous wire bending slot to receive said wire and guide the same into a series of convolutions, a die rod extending from each of said die members and means for engaging the extended ends of said die rods to change the relative positions of said die members.

3. A machine for bending a wire into helical form comprising means for moving the wire through a given path and a plurality of die-members having arcuate slots disposed in position to constitute a continuous slot to engage and bend said wire into a series of convolutions, a die rod extending from each of said die members and means engageable with the extended ends of said die rods to change the relative positions of said die members.

4. A machine for bending a wire into helical form comprising a pair of die members each having a slot disposed in a given plane and adapted to cooperate in forming a continuous die bending cavity and wire driving means for moving a wire into operative relation with said die-members, a die rod extending from each of said die members and means for changing the relative positions of the extended die rods to vary the relative positions of said die members.

5. A machine for bending a wire into helical form comprising a pair of die-members, each of said die-members having a cavity and a separator lip adjacent thereto, said cavities and lips being disposed to constitute a continuous wire bending slot and separator lip and means for guiding a wire into said slot to be formed into a helix with the convolutions thereof in given spaced relation.

6. A machine for bending a wire into helical form comprising a pair of die-members, each of said die-members having an oppositely inclined surface, a cavity in each of said surfaces and normally disposed in a common plane to constitute a substantially continuous wire bending slot to receive a wire to bend the same to helical form.

7. A machine for bending a wire into helical form comprising a pair of die-members, each of said die-members having an oppositely inclined surface, a cavity in each of said surfaces and normally disposed in a common plane to constitute a substantially continuous wire bending cavity to receive a wire to bend the same into a helix of a given diameter.

8. A machine for bending a wire into helical form comprising a pair of die-members, each of said die-members having an oppositely inclined surface, a cavity in each of said surfaces and normally disposed in a common plane to constitute a substantially continuous wire bending cavity to receive a wire to bend the same and means for changing the angular relation of said surfaces to vary the diameter of said helix.

9. A machine for bending a wire into helical form comprising means for driving a wire, a plurality of cavity die-members the cavities of said members being arranged to constitute a substantially continuous cavity to engage the driven wire to bend the same into a series of convolutions a die rod extending from each of said members and means for changing the relative positions of said rods to adjust the die-members.

10. A machine for bending a wire into helical form comprising wire driving means for moving a wire through a given path and a compound die member, each member having a cavity, said members being arranged to position the cavities in a common plane to constitute a continuous wire bending cavity to receive said wire to guide the same into a series of convolutions and means for adjusting the members to different planes.

11. A machine for bending a wire into helical form comprising wire driving means for moving a wire through a given path and a compound cavity die-member the cavities of said die member being disposed in a common

plane to receive said wire to guide the same into a series of convolutions, means for adjusting the component parts of said die to different planes and means for changing the relative positions of said cavity die member and said wire driving means.

12. A machine for bending a wire into helical form comprising means for moving the wire through a given path, a plurality of die-members having arcuate slots disposed in a common plane and positioned so that said slots constitute a continuous slot to engage and bend said wire into a series of convolutions, a die rod extending from each of said members and means for changing the relative positions of said die rods to adjust said die-members.

13. A machine for bending a wire into helical form comprising a pair of die-members each having a slot, means for supporting said members to arrange the slots to normally constitute a continuous wire bending cavity, wire driving means for moving a wire into operative relation with said die-members and means for laterally adjusting the positions of said members.

14. A machine for bending a wire into helical form comprising a pair of die-members disposed in a common plane, each member having a slot adapted to cooperate in forming a normally substantially continuous wire bending cavity, wire driving means for moving a wire into operative relation with said die-members, means for changing the relative positions of said members to dispose the slots in different planes and means for adjusting said die-members with respect to said wire driving means.

15. A machine for bending a wire into helical form comprising a pair of die-members, each of said die-members having a cavity and a separator lip adjacent thereto, means for supporting said members to position said cavities and lips to constitute a substantially continuous wire bending slot, means for guiding a wire into said slot to be formed into a helix with the convolutions thereof in given spaced relation and means for changing the relative positions of said die-members to vary the spaced relation of the formed helix.

16. A machine for bending a wire into helical form comprising a pair of die-members, each of said die-members having a cavity and a separator lip adjacent thereto, means for supporting said members to position said cavities and lips to constitute a substantially continuous coil forming slot, means for guiding a wire into said slot to be formed into a helix with the convolutions thereof in given spaced relation, means for adjusting said die-members with respect to each other to vary the spaced relation of the formed helix and means for adjusting said die-members with respect to said wire guiding means.

17. A machine for bending a wire into helical form comprising opposing surfaces each having a cavity, means for holding said surfaces in given relative positions to arrange said cavities to normally constitute a substantially continuous wire bending slot, means for driving a wire into said slot to produce a helix of a given diameter and means for changing the relative positions of said surfaces to break the continuity of said slot to produce a helix of a different diameter.

In testimony whereof, I have hereunto subscribed my name this 29th day of September, 1927.

FRANK W. WALTON.