Nov. 6, 1945. A. FREUNDLICH 2,388,401

MANUFACTURE OF HELICAL BINDERS

Filed Feb. 17, 1943 4 Sheets-Sheet 1

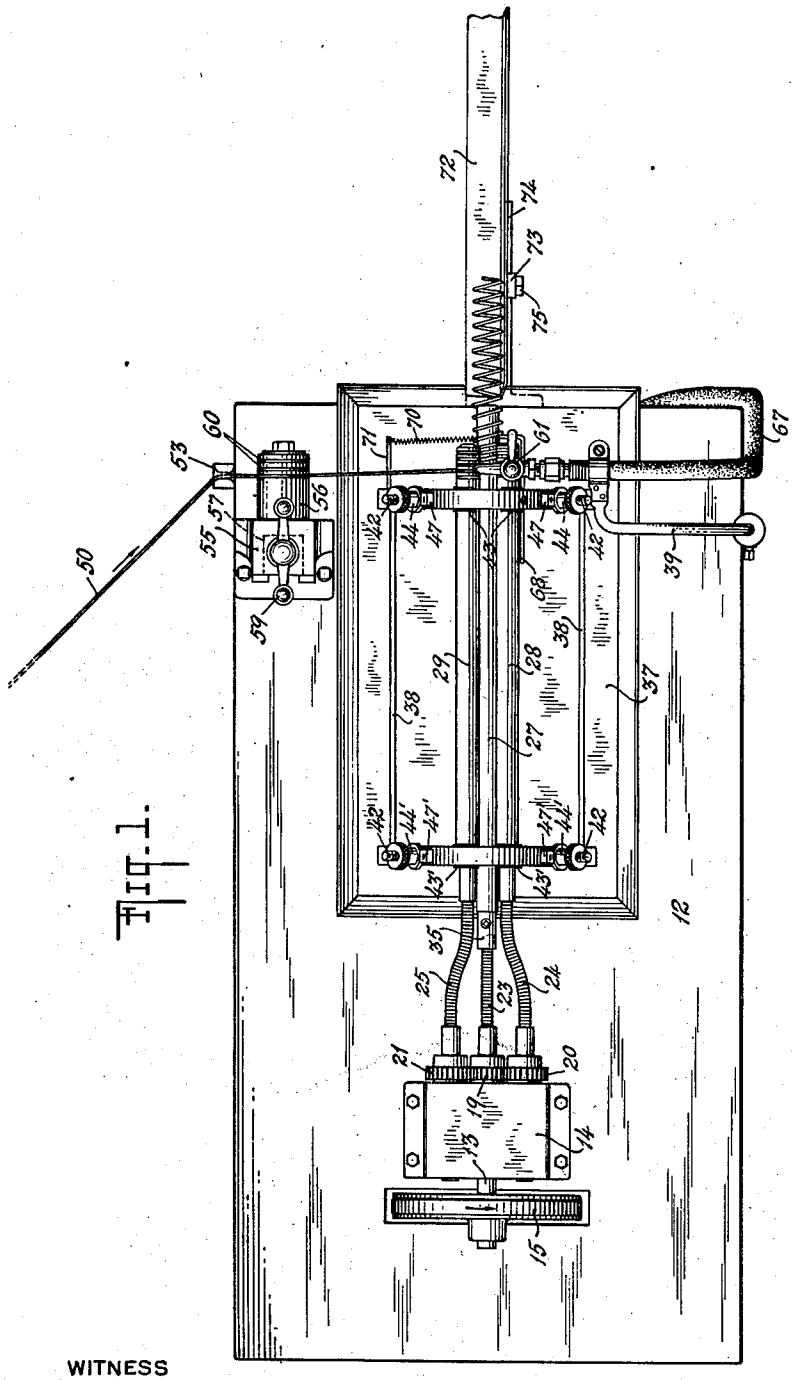


FIG. 1.

WITNESS

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MANUFACTURE OF HELICAL BINDERS

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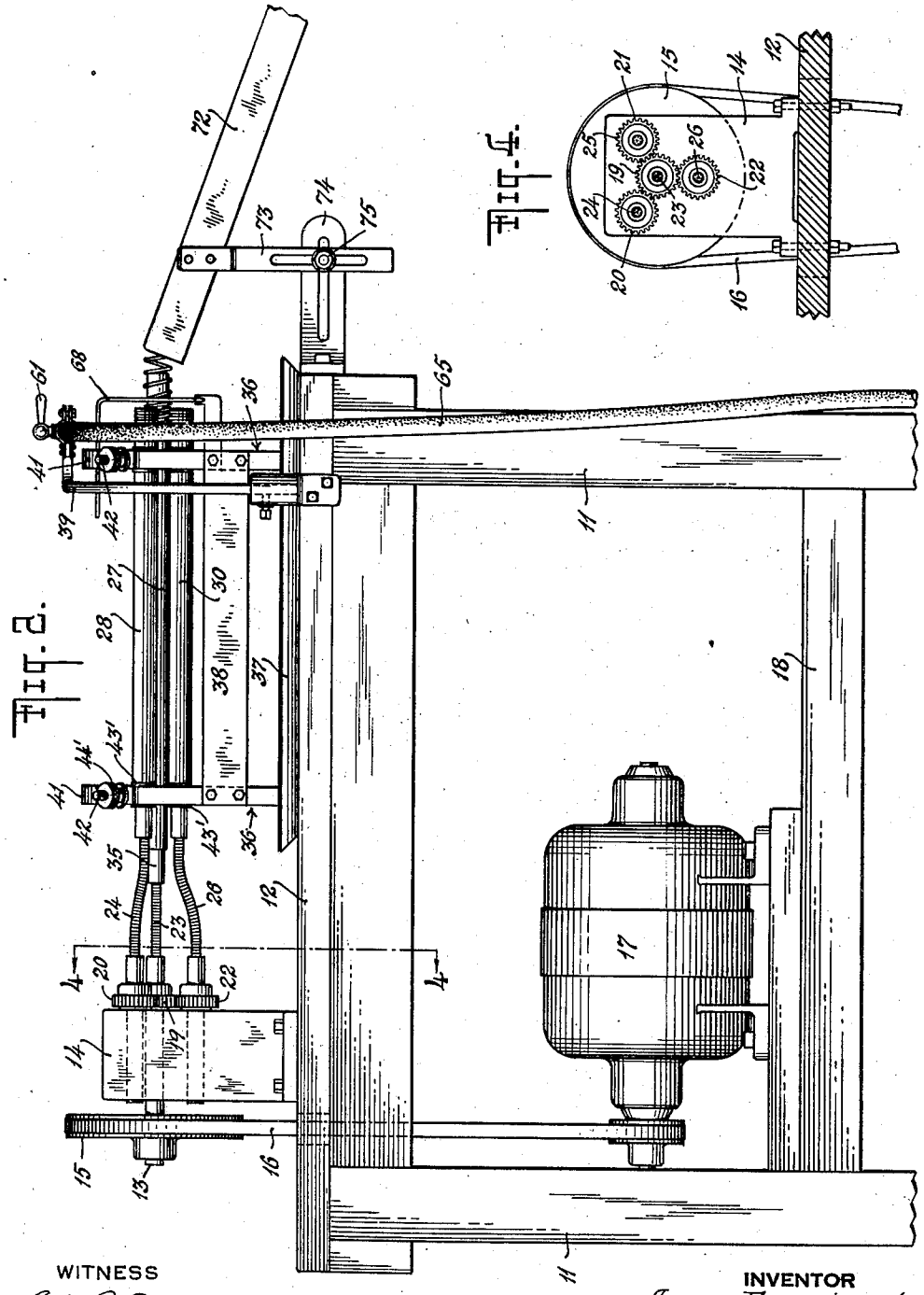


Fig. 2.

Fig. 4.

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MANUFACTURE OF HELICAL BINDERS

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Fig. 3.

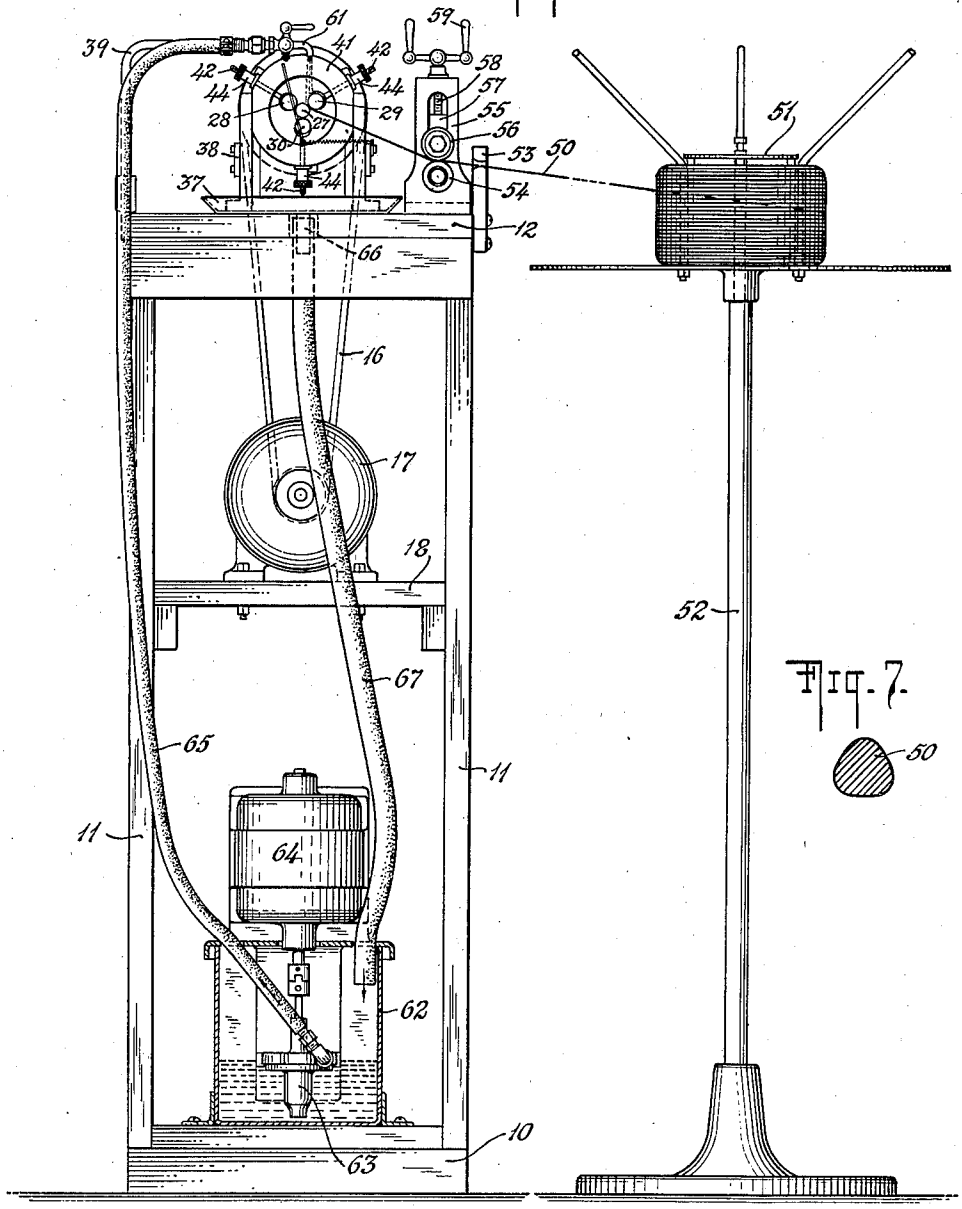


Fig. 7.

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MANUFACTURE OF HELICAL BINDERS

Filed Feb. 17, 1943 4 Sheets-Sheet 4

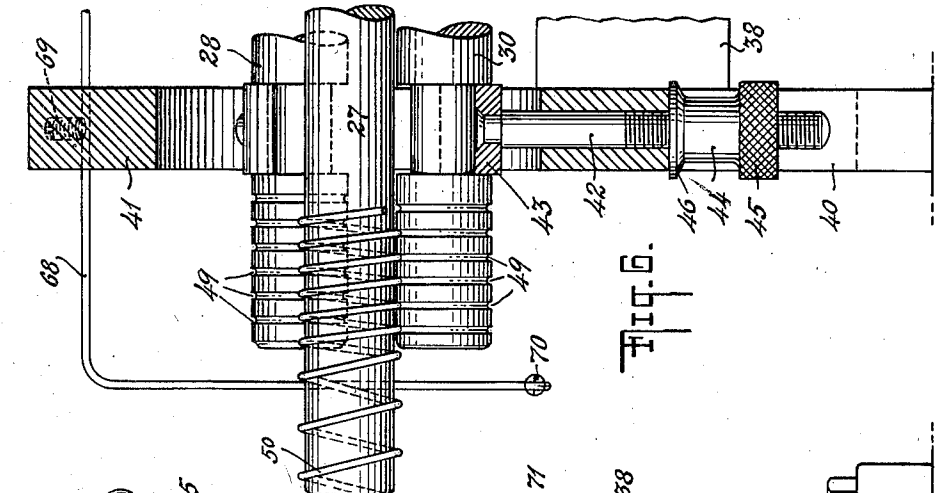


FIG. 5.

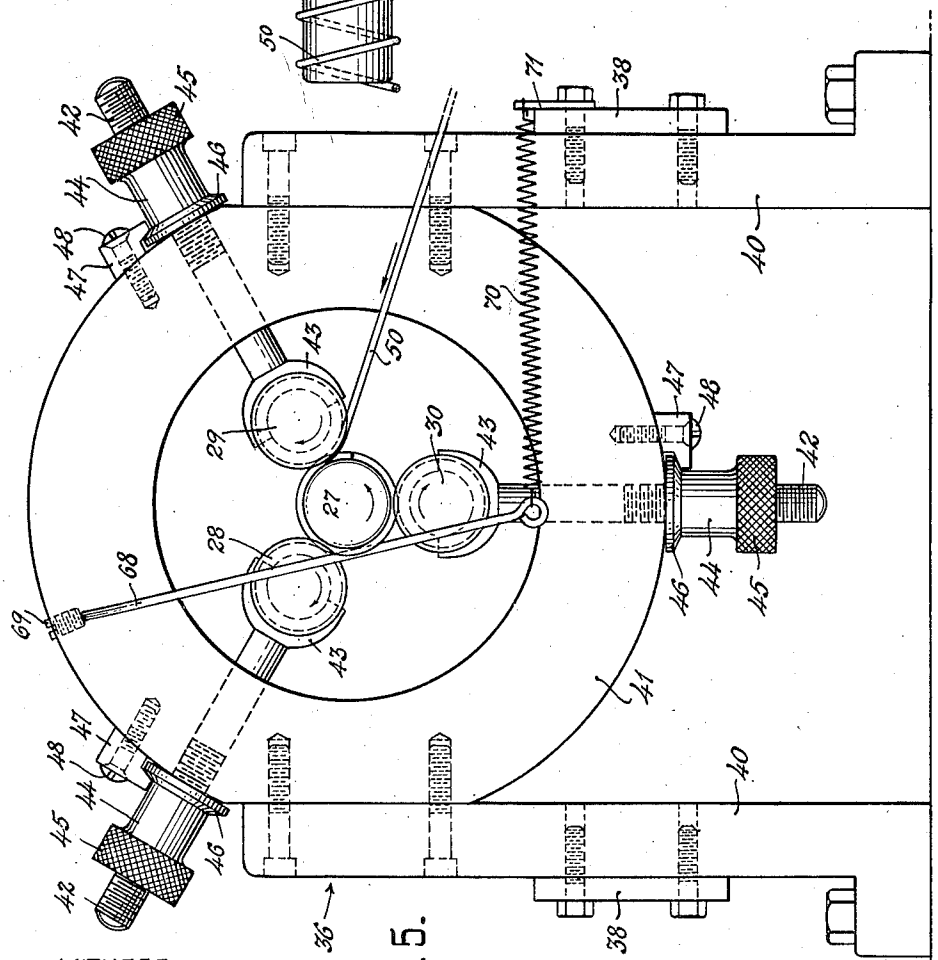


FIG. 6.

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Patented Nov. 6, 1945

2,388,401

UNITED STATES PATENT OFFICE

2,388,401

MANUFACTURE OF HELICAL BINDERS

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Application February 17, 1943, Serial No. 476,170

3 Claims. (Cl. 18—19)

This invention relates to the manufacture of spirally or helically coiled binding elements for use in securing in book form stacks of sheets having perforations therethrough adapted to receive such binding elements.

The principal object of the invention is to provide an improved method of and apparatus for manufacturing coiled or helical binder elements for books, pamphlets, and the like.

Another object of the invention is to provide an improved method of manufacture, which possesses special advantages in the construction of spirally or helically formed binding elements composed of thermoplastic or like material.

In accordance with the invention, a straight wire or filament utilized in the manufacture of the binder is formed into helical shape with the aid of frictional heat which is generated during the forming operation either by dragging, pulling, pushing or otherwise progressing the wire or filament between two or more contact surfaces movable relative to each other. The contact surfaces are preferably cylindrically shaped rollers which are rotated at different peripheral speeds and so constructed as to form, and at the same time to control, the diameter and pitch of the coils of the helical member. More specifically, the straight wire or filament to be formed into a helical binder is fed between a rotatable governing mandrel of predetermined diameter, and a plurality of grooved spacing rollers in approximate contact with the governing mandrel and constructed and arranged to rotate at a different peripheral speed than the governing mandrel.

For a better understanding of the invention as well as the advantages and features thereof, reference is made to the following description to be read in connection with the accompanying drawings in which Fig. 1 is a top plan view of the binder forming mechanism; Fig. 2 is a side elevational view of the forming mechanism and the motor for driving the same; Fig. 3 is a front elevational view of the entire machine; Fig. 4 is a sectional view taken along the line 4—4 of Fig. 2; Fig. 5 is an enlarged, detailed, front elevational view of the forward end of the forming mechanism; Fig. 6 is a side elevational view of the parts shown in Fig. 5; and Fig. 7 is an enlarged sectional view of the filament or thread in its finished form.

In the drawings, the numeral 10 indicates the base of the machine from which rises the four standards or uprights 11 for supporting the intermediate platform or motor bed 18 and the table 12 upon which is mounted the forming mechanism. As is shown more clearly in Figs. 1 and 2 of the drawings, the forming mechanism on the table 12 includes a drive shaft 13 which is rotatably supported in a bearing block 14 bolted to the table 12. The rearwardly projecting end of the shaft 13 is provided with a pulley wheel 15 which is connected by means of a belt 16 to the motor 17 mounted on the platform 18. Connected to the forward end of the drive shaft 13 is a driving gear 19 which is engaged with three driven gears 20, 21 and 22 rotatably mounted on gear shafts supported by the bearing block 14. The three gears 20, 21 and 22 are arranged in triangular relation around the centrally positioned driving gear 19 (see Fig. 4) and are similar to the latter so that all of such gears are rotated at the same rate of speed by the shaft 13, the gears 20, 21 and 22, however, being rotated in a direction opposite to the direction of rotation of the gear 19. Coupled in any suitable fashion to the gears 19, 20, 21 and 22 are the rear ends of four flexible shafts 23, 24, 25 and 26, respectively, the forward ends of such flexible shafts being connected to the elongated, rotatable, cylindrical members 27 28, 29 and 30, respectively. Thus the four cylindrical members 27 to 30 are rotated, through flexible shafts 23 to 26 and gears 19 to 22, at the same rate of speed by the shaft 13. The cylindrical members 28, 29 and 30, however, each have a diameter which is greater than that of member 27 (see Fig. 5) so that their peripheral speed is greater than the peripheral speed of the member 27. It will be noted also that the direction of rotation of the gears is such that members 28, 29 and 30 rotate in a clockwise direction, as viewed in Fig. 5 of the drawings, while member 27 rotates in a counterclockwise direction, as viewed in such figure.

The cylindrical member 27 functions as a mandrel as the filament is coiled therearound and is in the nature of a floating mandrel in that it is unsupported by bearings, but is merely confined in a space having transverse dimensions greater than the area of such member and formed between members 28, 29 and 30 which are arranged in triangular relation about such member 27 (see Fig. 5). Thus the member 27 is capable of a slight transverse movement with respect to the members 28, 29 and 30. Longitudinal movement of the member 27, however, is restricted by its connection with the drive shaft 23 which is separately connected to such member by the coupling member 35 attached in any suitable fashion, as by a set screw, to the reduced rear end of such member. Thus the mandrel 27 can be removed

readily from the machine and replaced by another mandrel 27 of different diameter to form a binding element having a different internal diameter. The length of the member or mandrel 27 is greater than that of the members 28, 29 and 30 so that its ends project beyond the ends of such members (note Fig. 2), and the exterior surface of such member is smooth throughout its length.

The three cylindrical members 28, 29 and 30 are supported in a predetermined relation with respect to the rotatable mandrel 27 by two spaced standards which are indicated generally by the reference numerals 36 and 36'. The two standards are mounted in a drip pan 37 and are maintained in spaced, upright relation by means of two bar plates 38, 38 which are bolted to the side legs of such standards. As both the standards 36 and 36' are similar in construction, except for the type of bearing support used in each, as will hereinafter be pointed out, it is believed only necessary to describe one of such standards in detail. For this purpose we have shown in Figs. 5 and 6 a detailed view of the forward standard 36, it being understood that the standard 36' is similar in all respects with the exception noted. As is shown in Figs. 5 and 6, the forward standard 36 includes a pair of spaced legs or uprights 40, 40 to the upper end portions of which is secured an annularly or ring shaped member 41 disposed vertically between such uprights. Provided in the member 41 are three radially disposed openings spaced 120° apart and through each of which extends a bearing member 42 provided with a screw thread on its outer end portion, and having at its inner end a U-shaped bearing support 43 which engages in an annular slot provided in the cylindrical member associated therewith. Provided on the outer threaded end of each member 42 is a nut 44 which seats on the periphery of the annular shaped member 41. The inner end of each of the nuts 44 is provided with a flange 46 having an outer beveled or chamfered surface, which is engaged by a projection provided on a block 47 secured to the annular member 41 in any suitable manner, as by the screw 48. Each nut 44 is provided with a knurled outer portion 45 by which the nut may be manipulated to advance or retract its associated bearing support 43, and consequently to fix the outer limit of movement of the forward end of its associated cylindrical member with respect to the mandrel 27. The bearing supports 43' of the members 42' in the standard 36' differ from the supports 43 in that they are annular in form and fit over the reduced rear end portions of the members 28, 29 and 30, the forward ends of the supports 43' being reduced in thickness so that they do not project beyond the peripheries of the members 28, 29 and 30. Thus unlike the supports 43, the supports 43' definitely fix the positions of the rear portions of the members 28, 29 and 30 with respect to the mandrel 27.

It will be understood from the foregoing that by manipulating the nuts 44 and 44', the members 28, 29 and 30 may be adjusted radially with respect to the mandrel 27. The adjustment of the members 28, 29 and 30 is such that with a mandrel 27 of a particular diameter, the filament being formed will maintain the members 28, 29 and 30 out of contact with such mandrel, as is shown in Fig. 5, while yet firmly engaging and compressing such filament. This adjustment, of course, will depend upon the thickness or gauge of the filament used in the manufacture of the binder.

The forward ends of the members 28, 29 and 30, that is, those portions of such members which project forwardly of the annular member 41, are each provided with a series of annular grooves 49, the grooves in such series being uniformly spaced from each other a distance equal to a predetermined pitch of the spiral or helical into which the filament is to be formed. The grooves of each member are longitudinally displaced with relation to the grooves of the other members, such displacement depending upon the position of the line of contact of the grooves of such member with the spiral being formed. Thus as the members 28, 29 and 30 are spaced apart 120° about the mandrel 27 in the embodiment illustrated and as this filament is first introduced between the member 29 and mandrel 27, the grooves of the member 28 are advanced one-third the distance between such grooves ahead of the grooves of the member 29, and the grooves of the member 30 are advanced a similar distance ahead of the grooves in the member 28, the preceding grooves of the member 29 being thus advanced a similar distance ahead of the succeeding grooves of the member 30. The cross-sectional configuration of the grooves is dependent upon the gauge of the filament used and, generally speaking, is of a depth less than the diameter of the smallest gauge of filament to be formed by members 28, 29 and 30 and of a width at the open ends of the grooves approximately equal to the diameter of the largest gauge filament to be formed by such members. For example, if the members 28, 29 and 30 are designed to form filaments having a range of diameter from .04 inch to .08 inch, the depth of each groove will be approximately .03 inch, while its width at the open end thereof will be approximately .08 inch. Each groove, therefore, will have a somewhat triangular form.

In the operation of the machine illustrated, the wire or filament 50 initially passes into the first groove of the cylindrical or contact member 29 and between the member 29 and mandrel 27, then between the latter and the first groove of the cylinder 28 which is in advance of the first groove of member 29 by one-third the pitch of the helical being formed, thence between mandrel 27 and the first groove of the cylinder 30 which is advanced from the first groove of cylinder 28, thence between the mandrel and the second groove of cylinder 29 and so on, the filament being thus progressively advanced by the successive grooves in the contact members 28, 29 and 30 towards the forward ends of such members. During this progressive feed of the filament 50, it is formed about the mandrel 27 into a helix whose pitch is determined by the spacings of the grooves 49 on the contact members 28, 29 and 30. Due to the fact that the peripheral speeds of members 28, 29 and 30 are greater than the peripheral speed of the mandrel 27, such members by their rubbing contact of the grooves 49 thereof with the filament 50, generate a frictional heat in sufficient intensity to heat the filament to a temperature where it is readily moldable about the mandrel 27. As a result of this frictional heat also, and the pressure exerted by the contact members 28, 29 and 30 on the filament 50, the cross-sectional form of the filament is changed from a circular to one which is substantially triangular in shape and conforming somewhat to the cross-sectional shape of the grooves 49. This modified form of the filament which is shown in Fig. 7 of the drawings, is of advantage in binders in that there is presented a wider contact to the

paper sheets than is possible with a circular form thereby lessening the danger of failure of a book along its bound edges. At the same time, the cross-sectional form imparts to the filament greater strength and rigidity in an axial direction without materially affecting the flexibility of the helical binder as a whole in a longitudinal direction. This is of particular advantage with binders made of thermoplastic or like material.

The filament or wire 50 is fed from a reel 51 rotatably mounted on a standard 52 (see Fig. 3) which may be placed in a convenient position with relation to the forming mechanism. On its way from the reel 51 to the forming mechanism, the wire or filament 50 passes through a guide aperture in a guide member 53 secured to a side of the table 12. From the guide 53 the wire passes between the tensioning rollers 54 and 56. The roller 54 is rotatably mounted on a stub shaft carried by a standard 55 secured to the table 12 adjacent to the fixed guide 53. The upper roller 56 is rotatably mounted on a stub shaft carried by a block 57 which is slidably mounted in a vertical guideway provided in the standard 55. The block 57 is provided with a vertically disposed threaded passageway which is engaged by a threaded rod 58 extending vertically up through the guideway of block 57 and having secured at its upper outer end a handle 59. Thus by rotating the threaded rod 58 through the handle 59, the position of the block 57 can be varied within the guideway of standard 55, and consequently the position of the roller 56 can be varied with respect to the roller 54. Preferably the relation of these two rollers is such that there is a slight pressure on the thread or filament 50 passing therebetween to provide a slight backward or controlling tension on the portion of the thread feeding from such rollers to the forming mechanism. As can be seen more clearly in Fig. 1 of the drawings, the roller 56 is provided with a plurality of annular grooves 60, each dimensioned to take care of wires falling within a predetermined gauge range.

During the formation of the filament or wire into a helical or spiral form on the forwardly projecting working portions of members 27 to 30, the heat generated is of such degree that it is necessary to provide a cooling medium to maintain the temperature of filament within certain limits. In the apparatus illustrated, the cooling medium, which may be of any type suitable for this purpose, is supplied by means of a faucet 61 (see Figs. 1 to 3 of the drawings) supported by a bracket 39 in proper position over the members 27 to 30 and connected by a hose or pipe connection 65 to a rotary pump unit 63 contained within a tank 62 for the cooling medium. The pump unit 63 is driven by a motor 64 supported by the tank 62 which is mounted upon the base 10 of the machine. The cooling medium discharged on the portion of the wire being formed is collected in the pan 37 and passes therefrom through a drain 66 into a return pipe 67, which empties into the tank 62, as is shown more clearly in Fig. 3 of the drawings.

The filament 50, as has been mentioned, is formed by the contact members 28, 29 and 30 about the mandrel 27 into a helix of predetermined pitch, such pitch corresponding to a helix of predetermined diameter. If a helix of larger diameter is to be formed on the apparatus using a gauge of wire falling within the range for which the grooves 49 of the members 28, 29 and 30 were designed, all that is necessary to do is to substitute a new mandrel 27 of the desired diameter between the members 28, 29 and 30 and readjust such members with respect to the new mandrel. In such case the pitch of the larger helical formed will probably be too close for the spacings of the apertures in the sheets which are to be formed by such helical, and means are provided to give to such larger helix its correct pitch for binding purposes. As is shown more clearly in Figs. 5 and 6 of the drawings, such means includes a substantially vertical portion of a bent rod 68 which engages the outer peripheral surface of the portion of the mandrel 27 projecting beyond the forward ends of the cylindrical or contact members 28, 29 and 30. Such portion of the rod 68 is so positioned with respect to the mandrel 27, that its point of engagement therewith is spaced from the last groove in the contact members, a distance equal to the distance between the coils of a helical having the desired pitch. Thus as the helically formed wire or filament is fed forwardly on the mandrel 27, the coils are spread by the rod 68 to the desired pitch and as the thermoplastic material is still warm and therefore readily moldable, the coils will readily assume and retain this new pitch, the wire when cooled permanently maintaining such pitch. The rod 68 has an upper horizontally disposed portion which extends through a horizontal opening in the upper part of the annular member 41 of the standard 35 and is secured in position by means of a set screw 69. The lower or free end of such substantially vertically disposed portion is secured to one end of a spring 70 which is connected at its other end to a plate 71 secured to one of the side plates 38 and adapted to yieldably maintain the rod 68 in engagement with the mandrel 27.

The finally formed wire is fed from the mandrel 27 into a trough like member 72 which is provided with indicating means for readily measuring the wire into predetermined lengths as it is fed through such member and to indicate to the operator the lengths into which the helically formed wires are to be cut. The member 72 is mounted on the upper end of an adjustable standard 73 supported by a bracket 74 secured to the forward end of table 12. The upright 73 and bracket 74 are provided with longitudinally extending slots through which extends a bolt 75 whereby the standard 73 may be adjusted relative to the bracket 74, and consequently making the trough 72 adjustable with respect to the discharge end of the mandrel 27.

While I have described and illustrated a preferred form of my invention in connection with a machine for manufacturing spiral binding elements, it is to be understood that as to certain phases thereof it may have other applications. It will be also understood to those skilled in the art that modifications and changes may be made in the machine illustrated without changing its essential functions. For example, instead of making the members 28, 29 and 30 of a different diameter than the mandrel 27, all of such members may be made of the same diameter and the differential surface speeds of such members attained by varying the construction of the gears 19 to 22. Also the peripheral speeds of the members 28, 29 and 30 may be varied relative to each other under certain conditions. As these and other changes may be made without departing from the spirit of the invention, I do not wish to limit myself to the machine illustrated and described but intend to include all structures

coming within the scope of the appended claims.

I claim:

1. In a machine for making helical members, the combination of a centrally disposed rotatable mandrel, a plurality of rotatable forming members arranged around said mandrel to define a longitudinally extending space having transverse dimensions greater than the cross sectional area of such mandrel in the region of such space, said mandrel being loosely mounted in said space and being confined therein by said members, each of said members having a series of annular grooves spaced from each other a distance equal to a predetermined pitch and the grooves of each member being longitudinally displaced with relation to the grooves on the other members, the surface of said mandrel in the region of the grooved portions of said members being smooth and of uniform cross-section, means for rotating said mandrel and said forming members and including a flexible driving connection with said mandrel to enable the latter to move transversely relative to said forming members, and means for adjusting said members radially with relation to said movable mandrel without affecting their driven connection with said rotating means.

2. In a machine for making helical members from a filament, the combination of a centrally disposed rotatable mandrel, a plurality of rotatable forming members arranged around said mandrel, each of said members having a series of annular grooves spaced from each other a distance equal to a predetermined pitch and the grooves of each member being longitudinally displaced with relation to the grooves on the other members, the surface of said mandrel in the region of the grooved portions of said members being smooth, said forming members defining a longitudinally extending space having transverse dimensions greater than the cross sectional area of said mandrel in the region of said space, said mandrel being loosely mounted in said space and being confined therein by said members, and means for rotating said mandrel and forming members and including a flexible driving connection with said mandrel to enable the latter to move transversely relative to said forming members, the cross sectional area of said movable mandrel, in the region of such space, being such that it is supported in a central position relative to said forming members by the filament being formed therearound by said forming members.

3. In a machine for making helical members from a filament, the combination of a centrally disposed rotatable mandrel, a plurality of rotatable forming members arranged around said mandrel, each of said members having a series of annular grooves spaced from each other a distance equal to a predetermined pitch and the grooves of each member being longitudinally displaced with relation to the grooves on the other members, the portion of said mandrel in the region of the grooved portions of said members having a smooth surface and a cross-sectional area throughout its length less than the transverse dimensions of the longitudinally extending space defined by said members so that the smooth surface of such mandrel portion is spaced from the exterior surfaces of the grooved portions of said members, and the depth of the grooves on said members being less than the diameter of the filament being formed and such that the filament being formed is pressed by said members against the smooth, spaced surface of said mandrel, means for rotating said mandrel and said forming members, the said parts being so constructed and arranged that the peripheral speed of rotation of said members is different from that of said mandrel, whereby the filament being formed is worked by pressure and frictional heat into a different cross-sectional configuration during the forming operation, the working end of said mandrel projecting beyond the grooved end portions of said members and functioning as a feeding guide for the helical member, means cooperating with such projecting end of the mandrel to give to the helical member the correct pitch desired, said last mentioned means comprising a rod adjustably mounted on the machine and, intermediate its length, engaging the periphery of the projecting end of said mandrel at a point spaced from the ends of said forming members a distance different from that between the grooves of such members, and means for yieldingly maintaining said rod in contact with said mandrel.

ALBERT FREUNDLICH.