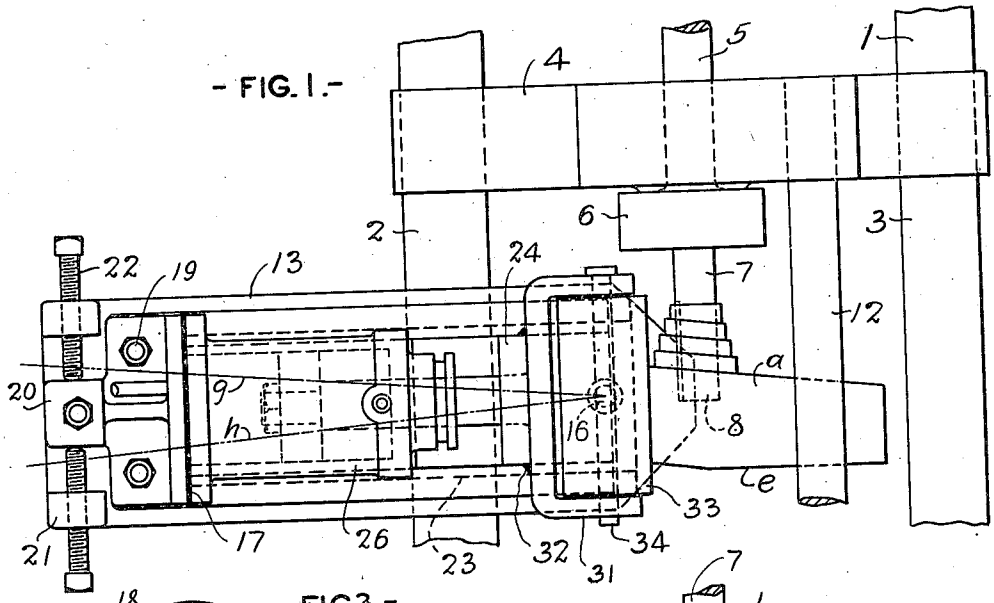
Oct. 17, 1939. H. S. PEYTON 2,176,719

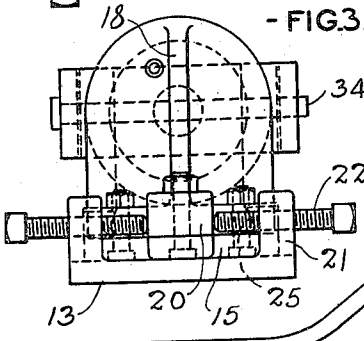
METHOD AND MACHINE FOR MAKING SPRINGS

Filed Aug. 3, 1938 3 Sheets-Sheet 1

- FIG. 1.-



- FIG. 3.-



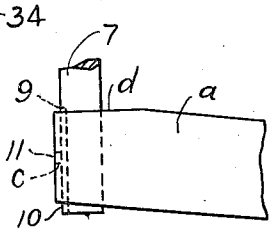


FIG. 4.-

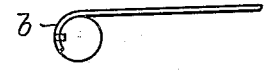
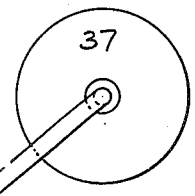
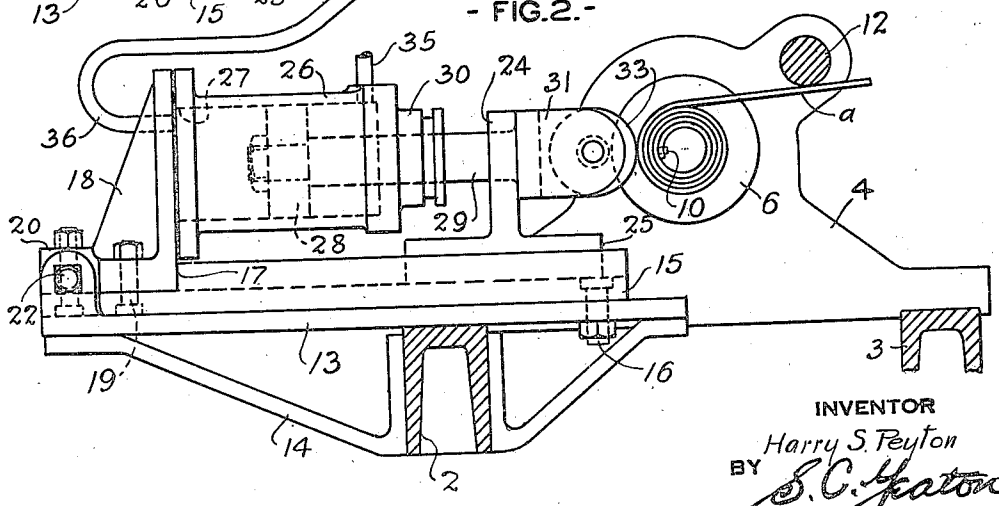


FIG. 5.-



- FIG. 2.-



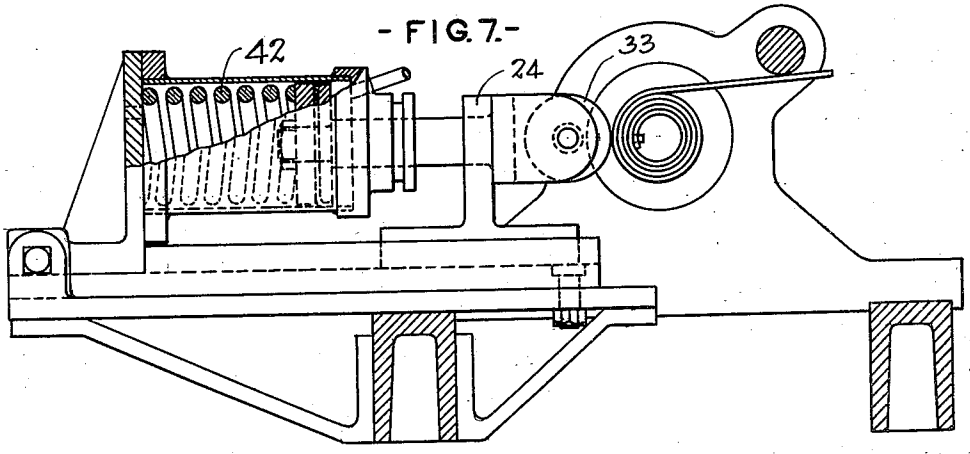
INVENTOR
Harry S. Peyton
BY S. C. Yeaton
ATTORNEY

Oct. 17, 1939. H. S. PEYTON 2,176,719

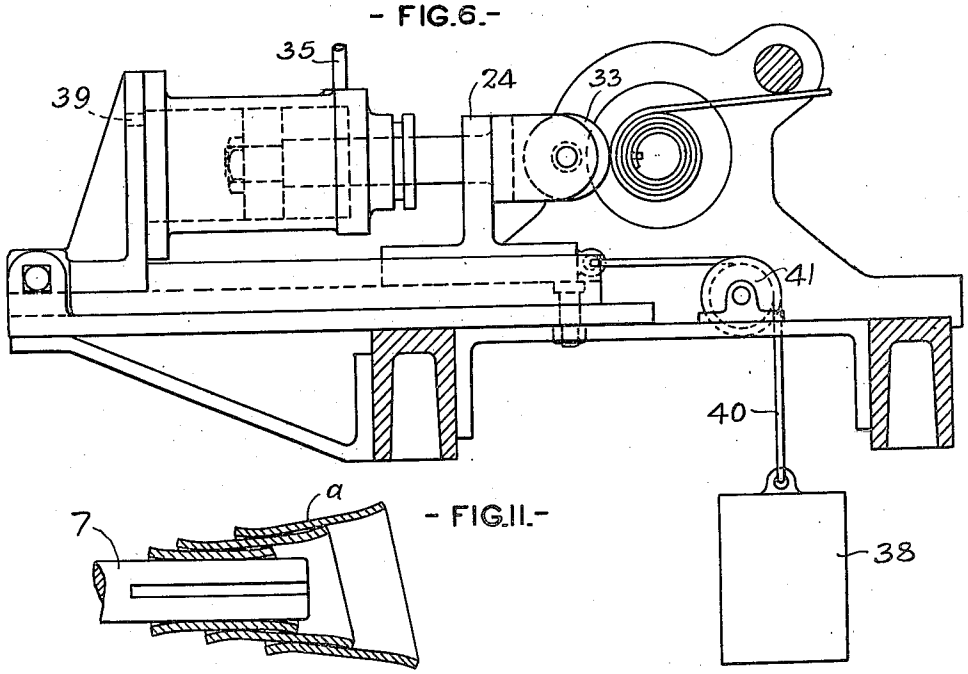
METHOD AND MACHINE FOR MAKING SPRINGS

Filed Aug. 3, 1938 3 Sheets-Sheet 2

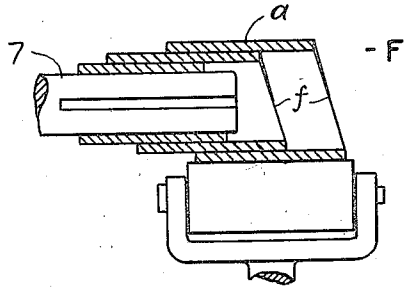
- FIG. 7.-



- FIG. 6.-



- FIG. 11.-



- FIG. 12.-

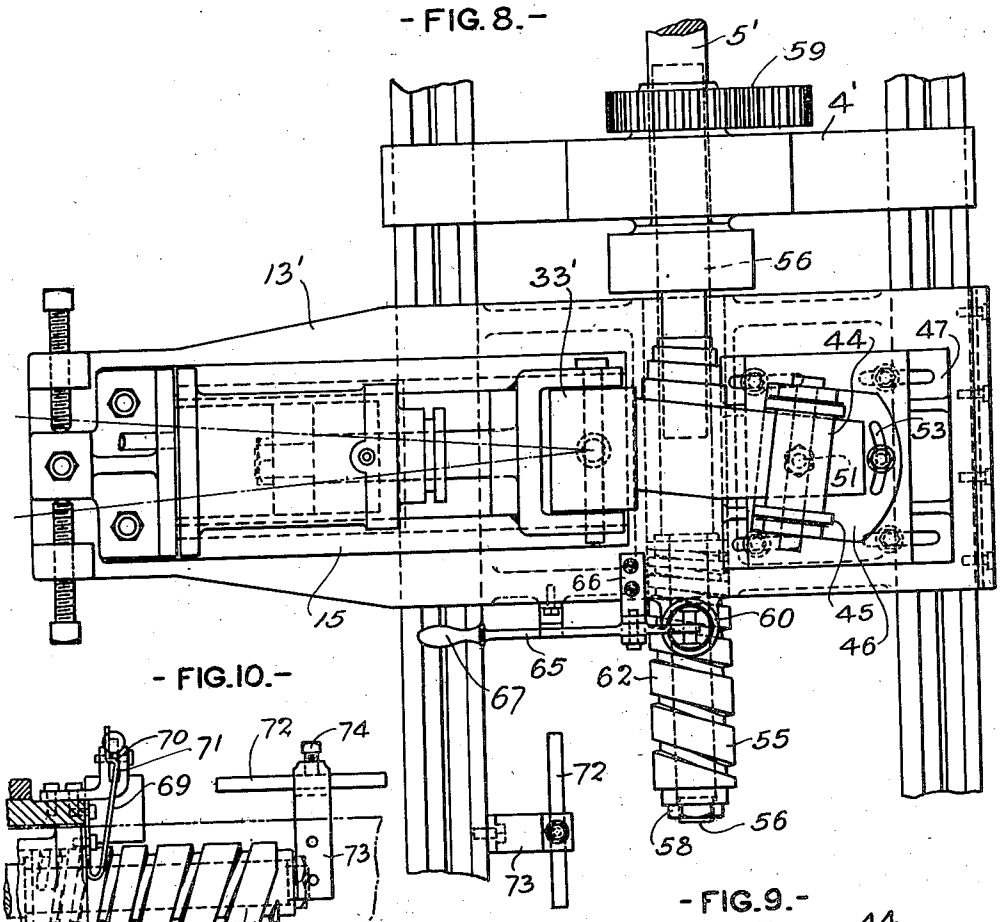
INVENTOR
Harry S. Peyton
BY S. C. Yeaton
ATTORNEY

Oct. 17, 1939. H. S. PEYTON 2,176,719

METHOD AND MACHINE FOR MAKING SPRINGS

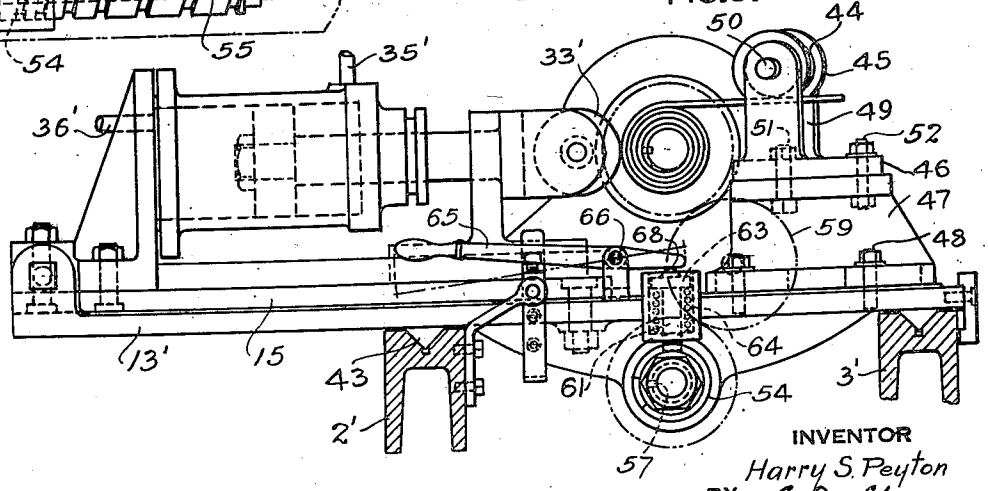
Filed Aug. 3, 1938 3 Sheets-Sheet 3

- FIG. 8. -



- FIG. 10. -

- FIG. 9. -



INVENTOR
Harry S. Peyton
BY S. C. Yeaton
ATTORNEY

Patented Oct. 17, 1939 2,176,719

UNITED STATES PATENT OFFICE

2,176,719

METHOD AND MACHINE FOR MAKING SPRINGS

Harry S. Peyton, Chicago Heights, Ill., assignor to American Locomotive Company, New York, N. Y., a corporation of New York

Application August 3, 1938, Serial No. 222,877

13 Claims. (Cl. 153—64)

This invention relates to a method of making volute springs, and to machines for carrying out the method.

The principal object of the invention is the devising of a method and means for making volute springs that are of improved structural characteristics, and more uniform than those constructed according to usual practice.

The springs which the present invention is adapted to make are formed from flat strip or bar spring metal stock, and in effecting the object aforementioned the main purpose is to produce springs having coils straight in cross section, i. e., in an axial direction or more nearly so than the present day volute springs.

In the usual manufacture of volute springs the strip, when wound upon the mandrel forming part of the machine, has a tendency to turn or curl up at one or both of its longitudinal edges. Such a spring is poorly adapted for the uses for which it is usually intended. The diameter of the spring is undesirably increased and uniformity in size cannot be attained. There is irregularity of the adjacent faces of the successive coils of the spring, with only partial contact at these faces. That is to say there is more or less point or line contact with spaces between the points or lines of contact instead of the uniform surface contact that is desired.

Surface contact is particularly important with springs of the volute type intended for use as friction springs, snubbers, etc. In such springs it is of primary importance that a high degree of surface contact between the engageable surfaces of the coils is made possible in order that sufficient snubbing or cushioning action may be had, and in order that uniformity of this action can be relied upon to make possible accurate calculations as to spring properties. This is important when determining the spring required for use either alone or in connection with other volute springs and other types of springs in any instance.

Referring to the drawings forming part of this application: Figure 1 is a plan view of part of a machine, illustrating the present invention, including the spring-pressing mechanism thereof; Fig. 2 is an end view of the machine of Fig. 1, shown partly in section, and including a fluid reservoir; Fig. 3 is a front elevation of the spring-pressing mechanism of the invention; Fig. 4 is a fragmental plan view of the free end portion of the mandrel of the machine and a piece of the strip or bar in position for winding; Fig. 5 is an end view of the parts shown in Fig. 4; Fig. 6 is a view similar to Fig. 2 showing a modified form of the spring-pressing mechanism; Fig. 7 is a view similar to Fig. 2, but partly broken away, showing another modified form of the spring-pressing mechanism; Fig. 8 is a view similar to Fig. 1, showing a machine of modified construction; Fig. 9 is a view similar to Fig. 2, of the machine shown in Fig. 8; Fig. 10 is a fragmental front elevation of a part of the machine of Fig. 8, partly in section and partly in dot and dash lines, showing a latch and releasing mechanism; Fig. 11 is a plan view of a portion of a mandrel with a volute spring supported thereon shown in section, showing the defects of the usual volute spring magnified; and Fig. 12 is a view similar to Fig. 11, showing a volute spring made by the present method and a portion of the spring-pressing mechanism.

To simplify the drawings, the frame of the machine and drive shaft are not shown in their entirety as they are of usual construction and form no part of the present invention. By "volute spring" is meant a spring employable either as a spring, a snubber, or both, which is formed by winding or coiling strip stock partly upon itself, the successive coils being off-set in step fashion in an axial direction and in extent depending upon the pitch desired.

Referring to Figs. 1 to 5, the machine comprises a frame 1 having longitudinal front and rear members 2 and 3 respectively and a cross member 4. A drive shaft 5 is journalled in the member 4 and a chuck 6 is secured to the inner end of this shaft. A mandrel 7 is firmly secured at an end portion thereof in the chuck 6, and the chuck 6 may be of any usual or preferred construction so that the mandrel may be removed therefrom and mandrels of different sizes employed suitable for the size of the spring that is to be manufactured. The mandrel 7 is preferably free or unsupported at its opposite end 8 as shown. Only the first coil of the spring directly engages the mandrel. Therefore a relatively short mandrel may be employed, and it has been found sufficient to support it only at one end. This leaves the opposite end free which facilitates stripping the spring.

The stock from which the spring is made is formed as flat bars or strips of proper gauge, width and length for the size of spring to be manufactured. The strip is heated to the required temperature before it is presented to the machine.

In Figs. 1 and 2 a bar or strip of stock is shown partly coiled, the strip being indicated by the reference letter *a*. Figs. 4 and 5 show the for-

ward end portion of the strip. The strip is preferably bent at its forward end to form a hook *b* for preshaping it to the mandrel to facilitate winding. As this end must rotate with the rotation of the mandrel it is necessary that it be suitably attached. In the present instance, as a simple and effective way of accomplishing this, the free end portion of the mandrel is provided with a longitudinal slot 9 open at the end 8. A key 10 slidably engages the slot and is provided with a projecting pin 11 which extends into a hole *c* formed in the hook *b*.

The strip is hooked onto the mandrel with the pin inserted in the hole as shown in Fig. 5, the strip extending rearwardly and the mandrel driven to rotate in a counterclockwise direction, whereby the strip is wound on the mandrel to form the spring. The strip is usually bent to form the hook *b*, and the hole *c* formed therein when the strip has been sufficiently heated to facilitate this. The spring is stripped from the machine by moving it axially toward the free end of the mandrel until it is clear of the mandrel, the key 10, with its pin 11, moving therewith through the slot, and after the spring has been stripped the key is removed from the spring, ready for use in the manufacture of another spring. Fig. 5 shows the mandrel formed with a shoulder for receiving the end of the hook *b*, and Fig. 9 shows, instead of the shoulder, the strip flattened or formed wedge-shape. Either construction may be employed.

The strip is placed at an angle to the axis of the mandrel as shown in Figs. 1 and 4 to provide for the pitch of the spring, the inclination of the strip increasing as the pitch increases. Accordingly the hook *b* is preferably directed at a corresponding angle to the longitudinal center line of the strip. According to common practice the strip is shaped at its forward end portion along the longitudinal edge to form a slanting edge *d* depending in angularity upon the pitch of the spring. This is the edge that will be exposed in the finished spring, and the slanting portion forms an end face of the spring. It consequently should be, when the strip is placed upon the mandrel, at right angles to the axis thereof. The strip is similarly cut at its rear end portion, along the opposite longitudinal edge, to form a slanting edge *e*, Fig. 1, to provide the opposite end face of the spring, these faces of the finished spring being in substantially parallel planes at right angles to the axis of the spring. The edge *d* being on the first or smallest coil of the spring, and the edge *e* being on the last or largest coil of the spring, the edge *d* will be much shorter than the edge *e*.

The hot bar or strip is guided upon the mandrel to give it the right pitch as the mandrel revolves, by an experienced operator who holds the rear end of the strip by means of tongs or other implement. It will be observed that in forming the volute spring the longitudinal rectilinear elements of the strip must be reformed into helixes, that is to say the strip must be entirely reformed with an endeavor to produce a perfect volute. This is what the operator strives to accomplish, but with present day practices distortion to a greater or less extent results. This distortion is somewhat crudely shown magnified in Fig. 11, but it illustrates what the present invention is directed to overcome. And in Fig. 12 these defects are shown as having been overcome by employment of the present method. Here the rectilinear elements of the strip are formed into helixes, a portion of one being shown at *f*, but in Fig. 12 a straight or flat cross section of the coil resembling that of the flat strip is shown as having been produced. The surface contact between the successive coils which results, possesses, for commercial use, the advantages already set forth, which are to a greater or less extent absent in the volute springs as ordinarily formed.

A preferably cylindrical, freely rotatable, bar 12 is disposed above and at the rear of the mandrel and is mounted at one end in the cross member 4 and at the other end in another cross member of the frame (not shown). The bar is similar to that commonly used in spring manufacturing machines. It engages the free or unwound portion of the strip and prevents it from turning with the mandrel. It aids in keeping the strip in place as it moves to the mandrel and therefore provides an aid to the operator. As thus far described the machines of Figs. 6 and 7 are similar to that of Fig. 1, and also, up to this point, the machine of Fig. 8 is similar, except as to the bar 12.

Coming now to the mechanism of Figs. 1 to 3 more particularly bearing on the present invention, this mechanism is essentially a spring-pressing mechanism. It comprises pressing means which presses upon the spring being formed, as the strip is being drawn by the revolving mandrel between this pressing means and the mandrel in the formation of the successive coils. This mechanism, or more strictly the pressing means thereof, prevents the distortion illustrated in Fig. 11, and is instrumental in producing the spring shown in Fig. 12.

In the preferred practice of the invention the pressing means engages the strip adjacent its forward end at the beginning of the rotation of the mandrel in the formation of the first coil and maintains pressure engagement with the strip until the last coil is formed.

The spring increases in diameter as the successive coils are formed. The last coil is therefore of considerably larger diameter than the first coil, depending in extent upon the number of coils constituting the volute and the thickness of the stock. Therefore a feature of the invention is to provide means whereby the pressing means may yield to permit this gradual increase in diameter, at the same time always providing sufficient pressure across the face of the coil being formed to attain the aforementioned objects sought.

Furthermore it is desirable that the pressing cease when the last coil has been formed, and means for accomplishing this forms an added feature of the invention. Preferably means are employed whereby the pressing means will be moved away from the finished spring so that it may be easily stripped from the mandrel in a manner already described.

Another feature, which may or may not be used as desired, is disposing the pressing means at an angle to the axis of the mandrel diverging therefrom in the direction of the travel of the strip axially of the mandrel. This angular position facilitates the strip moving axially at the proper rate to maintain the desired pitch.

Another feature of the structure in its preferred form, is to maintain a substantially uniform amount of pressure exerted by the pressing means upon the spring, although, as will later be seen, good results may be obtained with a somewhat variable amount of pressing.

It will be apparent that the features of the invention thus far set forth may be attained by variously constructed mechanisms, and these features are therefore claimed broadly to include such variations, which applies also to other features later to be described.

The pressing mechanism as shown in Figs. 1 to 3 comprises a bed 13 secured to the frame member 2 by brackets 14. A plate 15 seats upon this bed, and at its rear end portion, at its longitudinal center line, is pivoted to the bed by a bolt 16 having a countersunk head. The plate 15 at its front end portion is provided with a shoulder 17. A bracket 18 seats upon the plate adjacent this shoulder, and is secured to the plate by inverted bolts 19 having their heads countersunk in the plate. A lug 20 extends forwardly from the middle of the front of the bracket 18. Lugs 21 extend upwardly from the front end portion of the bed 13 in line with the lug 20. The lugs 21 have threaded orifices through which are screwed the adjusting screws 22. The ends of these screws abut the lug 20. By proper adjustment of these screws, in an obvious manner, the plate 15 may be turned about the pivot bolt 16 from its normal or central position in either direction, as indicated by the dot and dash lines *g* and *h* shown in Fig. 1.

The plate 15 is provided with a longitudinally extending dovetail groove 23 extending from the shoulder 17 to the rear end of the plate. A bracket 24 is supported by the plate 15 within the groove and has a longitudinally extending dovetailed base 25 engaging the dovetail groove 23, whereby the bracket may move longitudinally of the plate.

A cylinder 26, having an open front end 27, is secured to the bracket 18 by means of bolts (not shown), the bracket 18 forming a head for the open end 27 of the cylinder. A piston 28 is disposed in the cylinder and is provided with a piston rod 29 which extends through a stuffing box 30 at the rear end of the cylinder. The piston rod passes through the bracket 24 and is provided at its rear end with a fork 31 which engages the bracket 24 and is secured thereto by means of welds 32 (see Fig. 1).

A roller 33 is disposed between the branches of the fork 31 and is mounted on a pin 34 secured to the branches of the fork 31. The roller is thus freely mounted to rotate and provides the before-mentioned pressing means for the spring, having line to line contact with the coils as they are being formed. The roller of this embodiment has no axial movement and therefore is made sufficiently long to extend outwardly across the spring so that it will have pressure contact across the full width of the strip as it is being coiled. It will however be understood that other types of pressing means may be employed, for instance one that does not rotate, such as a fixed bar, or one that has more than a single line of contact, as for instance two fixed bars.

The cylinder 26 is provided with means whereby fluid under pressure, preferably compressed air, may be introduced and discharged at each end of the piston in the required order. The piston, and its associated parts, due to the compressed air in the cylinder forward of the piston, provides actuating means for supplying the pressure to the roller 33, the bracket 24 being free to slide to permit the application of the pressure to the spring. This pressure, being furthermore yielding, the roller 33 is permitted to be gradually forced away from the mandrel as the volute spring is being formed and increases in diameter. The cylinder 26 may be supplied with fluid in any suitable manner. The piping, valves, etc., are not shown except at the rear end of the cylinder a pipe 35 is shown which may be employed as both a supply pipe and exhaust pipe. Likewise at the front end of the cylinder is a pipe 36 which may be employed as both a supply pipe and an exhaust pipe. However any suitable system of piping and connections may be employed for operating the piston by the compressed fluid.

When the spring is being formed the pipe 35 is open to exhaust and the compressed air or other fluid is supplied to the cylinder through the pipe 36, which operates to press the roller 33 against the spring coils as they are being formed, this pressure being sufficient to produce a spring of the improved characteristics already mentioned. When the formation of the spring has been completed the pipe 36 may be open to exhaust and the rear end of the cylinder supplied with the pressure fluid through the pipe 35 thereby moving the piston 28 forward and the roller 33 away from the finished spring. The spring can then be stripped from the mandrel. No fluid need be supplied to the rear end of the cylinder, and the pipe 35 may be used only to connect this end with the atmosphere as desired. The roller 33, in the position it will assume when the last coil is formed, will not be seriously in the way when stripping the spring from the mandrel. At this position of the roller, if pressure is maintained in the front end of the cylinder, the roller mounting should be held fixed to permit stripping of the spring.

The pipe 36 may, as shown in Fig. 2, be connected to a reservoir 37, and this reservoir may be of a suitable size to hold sufficient compressed air or other fluid so that there will be substantially no difference in the pressure upon the roller as it moves away from the mandrel, during the coiling operation. Thus a substantially uniform pressure can be maintained upon the spring. In this case, to move the roller 33 away from the finished spring preparatory to stripping it from the mandrel, the pressure of the fluid entering the cylinder through the pipe 35 must be sufficiently high to move the piston 28 forward against the pressure in the reservoir 37. Instead of employing pipe 35 in this way, the roller mounting may be held fast by any desired means, as already mentioned.

The design shown in Fig. 6 differs from the design shown in Fig. 1 only in that instead of the supply pipe 36 at the forward end of the cylinder, a weight 38 is employed and the forward end of the cylinder is connected to atmosphere through an opening 39. The weight is connected to the bracket 24 by a cable 40 which passes over a pulley 41. The roller 33 presses against the spring with a constant pressure, being permitted movement in a direction away from the mandrel as the coils are being formed, all quite similar to that of the design of Fig. 1; also the fluid pressure supplied to the rear end of the cylinder through the pipe 35 must be sufficient to overcome the weight 38.

The design of Fig. 7 differs from the design of Fig. 6 in that, instead of the weight 38 and its associated parts, a compression spring 42 is disposed in the cylinder between the forward end thereof and the piston. This does not provide a uniform pressure for the roller 33 as does the designs of Figs. 1 and 6. Otherwise the design of Fig. 7 is similar to the designs of Figs. 1 and 6.

Figs. 8 to 10 show a different embodiment. Here the spring-pressing mechanism is similar to that of Fig. 1, although obviously it may, if desired, be replaced by either the design of Fig. 6 or that of Fig. 7. No further description of this mechanism is deemed necessary except to say that, in the present embodiment, the roller 33' is preferably made considerably shorter. This is merely because the roller moves in a direction axially of the mandrel with the strip as it is being coiled, and therefore need be but a little longer than the width of the strip. Instead of the bed 13' being secured to the front frame member, as is the bed 13 of Fig. 1, it is extended to the rear frame member 3'. The bed 13' is associated with the frame members 2' and 3' through the tongue and groove connections 43 to permit the bed to slide in a direction axially of the mandrel. Instead of the bar 12 of the previously described designs a roller 44 having flanges 45 is employed. This roller serves somewhat the same purpose as the bar 12 except that the flanges on the roller 44 confine the strip as it passes between them and insure that the proper pitch of spring is effected, as will presently be seen.

The roller 44 is mounted upon a bracket 46 which bracket is mounted upon a second bracket 47. The bracket 47 is connected to the bed 13' by bolts 48 which pass through elongated holes in the bracket 47 to permit adjustment of the bracket in directions at right angles to the mandrel to secure the best position thereof for each size of spring.

The roller 44 is mounted between the branches of the fork 49 of the bracket 46 upon a pin 50 secured in the branches. The bracket 46 is pivotally connected to the bracket 47 by a bolt 51 and further connected by a bolt 52 which passes through an arcuate slot 53 in the bracket 46. The bracket 46 may thus be turned about the pivot bolt 51 to adjust the roller 44 to correspond to the pitch of the volute being formed. The flanges 45 are spaced to accommodate a strip of definite width. The roller 44 is removable and replaceable by other rollers so that a roller may be chosen having the proper space between the flanges in any instance.

The pressing mechanism and the roller 44 move with the bed 13', and to provide for this movement the bed 13' has, depending from its bottom face, a cylindrical bore 54. A hollow screw 55 is mounted on a shaft 56 which passes through the bore 54. The screw 55 seats against a shoulder of the shaft 56. It is secured to the shaft by a key 57 and further secured by a nut 58. The shaft 56 is journalled in the cross frame member 4' and is connected to the shaft 5' by a train of gears 59. One of these shafts is positively driven and the other shaft is rotated thereby in the same direction. Preferably the shaft 5' will be positively driven and the gears of the train 59 may be interchangeable with other gears, all in the usual manner, to permit the desired relative speed between the two shafts.

The bed 13', at a point above the screw 55, is provided with a vertical cylinder 60. A pin 61 extends through the lower head of the cylinder, and at its lower end engages the groove between the threads of the screw 55 whereby when the shaft 5' is driven to rotate the mandrel and the shaft 56, the bed 13' and the mechanism secured thereon will move in a direction axially of the spring with a speed equal to the pitch of the spring. That is to say with one revolution of the mandrel, the roller 33' will move in a direction away from the first coil axially of the spring for a distance equal to the pitch of the spring. The pitch of the spring is determined by the pitch of the screw 55 and the screw is replaceable by other screws of different pitches so that a volute spring of the desired pitch may be made.

In Fig. 8 the volute spring is shown of increasing pitch, the pitch increasing as the diameter increases. This provides for uniform stress throughout the spring. To form such a spring the screw 55 is provided with threads 62 of similarly increasing pitch.

The screw 55 is removable from the shaft 56, so that screws of different pitch may be employed as occasion requires.

The pin 61 is provided with a head 63 and the upper end of the cylinder 60 is open so that the pin may be inserted into the cylinder therethrough. Beneath the head 63 and bottom head of the cylinder is a compression spring 64 which functions, when free so to do, to raise the pin from engagement with the groove of the screw threads. Means is provided that this shall so operate when the spring has been completed upon the mandrel. This will obviously stop the movement of the bed 13'. The pin 61 is depressed, against the tension of the spring 64, into engagement with the groove of the screw 55 by means of a hand lever 65, fulcrumed on a bracket 66 secured to the bed 13'. The lever at one end is provided with a handle 67, and the opposite end, when the handle is raised by the operator, engages a knob 68 formed on the head 63, and forces the pin into engagement with the groove.

A spring latch 69, provided with a shoulder 70, is bolted to the bed 13'. The latch 69 has a spring portion 71 inclined upwardly in a direction toward the lever. The lever swings in a vertical plane and as the handle is raised the lever engages this portion 71 forcing it out of the path of the lever until the lever has reached the shoulder 70 whereupon it is free from the portion 71 and the resiliency of this portion acts to throw the shoulder into engagement with the lever to hold it in its raised position and the pin 61 in engagement with the screw.

A rod 72 is disposed in advance of, and opposite to, the latch portion 71. When the bed 13' has moved far enough, in a direction toward the rod 72, the latch portion 71 will engage the end of the rod and will be moved thereby away from the handle so that the handle will be free of the shoulder 70. This leaves the spring 64 free to raise the pin 61 from engagement with the screw thereby stopping further movement of the bed 13'.

The rod 72 is adjustably mounted in a bracket 73 secured to the frame member 2'. A set screw 74 locks the rod in any adjusted position. The rod, in practice, is adjusted to release the latch when the volute spring has been completed upon the mandrel.

The operation of the roller 33' and the stripping of the spring from the mandrel are similar to what has already been described in connection with the design of Fig. 1.

No provision is shown for returning the bed 13' to initial position but this can be done by hand or by any means desired, as for instance by means of a weight, in an obvious manner, similar to that shown in Fig. 6, or if desired the screw 55 may be reversed. Furthermore as, in this design the bed 13' travels, flexible pipe fittings connected to the pipes 35' and 36' will ordinarily be required.

It will be noted in each embodiment the pressing roller exerts a pressure upon the spring and this must be sufficient to produce a volute spring having the characteristics aforesaid. The pressure of the roller is yielding, which is necessary to compensate for the gradually increasing diameter of the volute, and furthermore to provide for inequalities in the stock forming the strip or bar, and, when required, to compensate for the reduction in the thickness of the strip at the end portions which are often made tapered in thickness.

While mechanical means have been shown for forcing the pressing roller against the spring, it will be obvious that this may be done by hand by the employment of a lever or other mechanical means providing a yielding pressure if desired. Furthermore, while in Figs. 6 and 7 the weight **38** and compression spring **42** are respectively employed for producing the pressure for the pressing roller, it will be understood that these may be reversed. That is to say the pressure may be produced by a compressed fluid, and, as to Fig. 6, the weight suitably disposed to move the roller away from the volute spring when it has been completed, and as to Fig. 7, the spring **42** disposed in the other end of the cylinder.

The invention claimed and desired to be secured by Letters Patent is:

1. A machine comprising a mandrel for winding thereupon a flat metal strip into consecutive partially overlapping windings to form a volute upon said mandrel having consecutive partially overlapping convolutions; means for holding the forward end of said strip upon said mandrel with said strip inclined to the axis of said mandrel to provide for the pitch of said convolutions during rotation of said mandrel; means for rotating said mandrel; means disposed opposite said mandrel for pressing against said strip as it is being wound; and means providing a yielding pressure against said pressing means in the direction of said mandrel during said winding.

2. A machine for winding flat metal strips into volute springs comprising a mandrel upon which the strip is wound; means for holding the forward end of said strip for rotation thereof with rotation of said mandrel; means disposed opposite said mandrel for pressing against said strip as it is being wound; means providing a yielding pressure against said pressing means in the direction of said mandrel during said winding; means for guiding said strip to said mandrel; and means for simultaneously rotating said mandrel and moving said guiding means in a direction axially of said mandrel including means for governing the pitch of said volute spring.

3. A machine for winding flat metal strips into volute springs comprising a mandrel upon which the strip is wound; means for holding the forward end of said strip for rotation thereof with rotation of said mandrel; means disposed opposite said mandrel for pressing against said strip as it is being wound; means providing a yielding pressure against said pressing means in the direction of said mandrel during said winding; means for guiding said strip to said mandrel; means for rotating said mandrel; and means for moving said guiding means in a direction axially of said mandrel simultaneously with the rotation of said mandrel at a gradually increasing speed relative to the speed of said mandrel whereby a volute spring of gradually increasing pitch may be produced.

4. A machine for winding flat metal strips into volute springs comprising a mandrel upon which the strip is wound; means for holding the forward end of said strip for rotation thereof with rotation of said mandrel; means disposed opposite said mandrel for pressing against said strip as it is being wound; means providing a yielding pressure against said pressing means in the direction of said mandrel during said winding; means for guiding said strip to said mandrel; means for rotating said mandrel; and means for moving said guiding means in a direction axially of said mandrel simultaneously with the rotation of said mandrel at a gradually increasing speed relative to the speed of said mandrel, said increase in said speed being proportional to the simultaneous increase in the diameter of said volute spring whereby a volute spring may be produced of substantially uniform stress throughout.

5. A machine for winding flat metal strips into volute springs comprising a mandrel upon which the strip is wound; means for holding the forward end of said strip for rotation thereof with rotation of said mandrel; means disposed opposite said mandrel for pressing against said strip as it is being wound; means providing a yielding pressure against said pressing means in the direction of said mandrel during said winding; means for guiding said strip to said mandrel; means for rotating said mandrel; and means, including a drive screw, for moving said guiding means in a direction axially of said mandrel simultaneously with the rotation of said mandrel, said screw being provided with a thread of gradually increasing pitch for moving said guiding means at a gradually increasing speed relative to the speed of said mandrel, said increase in said thread pitch being proportional to the simultaneous increase in the diameter of said volute spring whereby a volute spring may be produced of substantially uniform stress throughout.

6. A machine for winding flat metal strips into volute springs comprising a mandrel upon which the strip is wound; means for holding the forward end of said strip for rotation thereof with rotation of said mandrel; means disposed opposite said mandrel for pressing against said strip as it is being wound; means providing a yielding pressure against said pressing means in the direction of said mandrel during said winding; means for guiding said strip to said mandrel; and means for simultaneously rotating said mandrel and moving said guiding means and said pressing means in a direction axially of said mandrel.

7. A machine comprising a mandrel for winding thereupon a flat metal strip into consecutive partially overlapping windings to form a volute upon said mandrel having consecutive partially overlapping convolutions; rigid pressing means disposed opposite said mandrel for pressing said strip exteriorly entirely across its width as it is being wound; means for rotating said mandrel; means for holding the forward end of said strip upon said mandrel with said strip inclined to the axis of said mandrel to provide for the pitch of said convolutions during rotation of said mandrel, each successive convolution interiorly thereof opposite said rigid means being thereby, for a portion of its width indirectly supported by said mandrel, for a portion of its width directly supported by the adjacent convolution previously formed and for the remainder of its width unsupported; and automatically operable means supplying a constant yielding pressure, opposed by said mandrel, urging said rigid means toward said mandrel in pressing engagement with said strip, said

yielding pressure being of a magnitude sufficient to enable said rigid means to shape said strip across its entire width, as it is being wound into a volute, and to press each said successive convolution across its said indirectly supported portion tightly against the adjacent previously formed convolution, said rigid means being adapted to automatically gradually recede from said mandrel against said yielding pressure to compensate for the gradually increasing diameter of the volute being formed.

8. A machine comprising a mandrel for winding thereupon a flat metal strip into consecutive partially overlapping windings to form a volute upon said mandrel having consecutive partially overlapping convolutions; rigid pressing means disposed opposite said mandrel for pressing said strip exteriorly entirely across its width as it is being wound; means for rotating said mandrel; means for holding the forward end of said strip upon said mandrel with said strip inclined to the axis of said mandrel to provide for the pitch of said convolutions during rotation of said mandrel, each successive convolution interiorly thereof opposite said rigid means being thereby, for a portion of its width indirectly supported by said mandrel, for a portion of its width directly supported by the adjacent convolution previously formed and for the remainder of its width unsupported; and automatically operable means supplying a constant yielding pressure, opposed by said mandrel, urging said rigid means toward said mandrel in pressing engagement with said strip, said yielding pressure being of a magnitude sufficient to enable said rigid means to shape said strip across its entire width, as it is being wound into a volute, and to press each said successive convolution across its said indirectly supported portion tightly against the adjacent previously formed convolution, said rigid means being adjustable to be disposed at an angle to said mandrel diverging therefrom in the direction of the travel of said strip axially of said mandrel to increase the pressure at the edge of said strip comprised in said indirectly supported portion, said rigid means being adapted to automatically gradually recede from said mandrel against said yielding pressure to compensate for the gradually increasing diameter of the volute being formed.

9. A machine comprising a mandrel for winding thereupon a flat metal strip into consecutive partially overlapping windings to form a volute upon said mandrel having consecutive partially overlapping convolutions; rigid pressing means disposed opposite said mandrel for pressing said strip exteriorly entirely across its width as it is being wound; means for rotating said mandrel; means for holding the forward end of said strip upon said mandrel with said strip inclined to the axis of said mandrel to provide for the movement of said strip axially of said mandrel to produce the pitch of said convolutions during rotation of said mandrel, each successive convolution interiorly thereof opposite said rigid means being thereby, for a portion of its width indirectly supported by said mandrel, for a portion of its width directly supported by the adjacent convolution previously formed and for the remainder of its width unsupported; means for moving said rigid means relative to said mandrel and axially thereof to accord with said movement of said strip axially of said mandrel; and automatically operable means supplying a constant yielding pressure, opposed by said mandrel, urging said rigid means toward said mandrel in pressing engagement with said strip, said yielding pressure being of a magnitude sufficient to enable said rigid means to shape said strip across its entire width, as it is being wound into a volute, and to press each said successive convolution across its said indirectly supported portion tightly against the adjacent previously formed convolution, said rigid means being adapted to automatically gradually recede from said mandrel against said yielding pressure to compensate for the gradually increasing diameter of the volute being formed.

10. A method of winding a flat metal strip upon a revolving mandrel to form a volute having consecutive partially overlapping convolutions, the forward end of said strip engaging and being secured to said mandrel and said strip being inclined to the axis of said mandrel to provide for the pitch of said convolutions, which method consists in pressing against said strip exteriorly for its entire width as it is being wound, by a rigid pressing means opposed by said mandrel; and simultaneously moving said strip axially of the mandrel at a speed to produce said pitch of said convolutions as the mandrel revolves, so that each successive convolution opposite the pressing means will be interiorly, for a portion of its width indirectly supported by the mandrel, will be for a portion of its width directly supported by the adjacent convolution previously formed and will be for the remainder of its width unsupported, the pressure of said pressing means being of sufficient magnitude to shape said strip across its entire width as it is being wound into a volute, and to press the indirectly supported portion tightly against the adjacent previously formed convolution.

11. A method of winding a flat metal strip upon a revolving mandrel to form a volute having consecutive partially overlapping convolutions, the forward end of said strip engaging and being secured to said mandrel and said strip being inclined to the axis of said mandrel to provide for the pitch of said convolutions, which method consists in pressing against said strip exteriorly for its entire width as it is being wound, by a rigid pressing means opposed by said mandrel; and simultaneously moving said strip axially of the mandrel at a speed to produce said pitch of said convolutions as the mandrel revolves, so that each successive convolution opposite the pressing means will be interiorly, for a portion of its width indirectly supported by the mandrel, will be for a portion of its width directly supported by the adjacent convolution previously formed and will be for the remainder of its width unsupported, the pressure of said pressing means being of sufficient magnitude to shape said strip across its entire width as it is being wound into a volute, and to press the indirectly supported portion tightly against the adjacent previously formed convolution, said pressure being enhanced opposite the edge of said strip comprised in said indirectly supported portion to more tightly press said edge against the adjacent previously formed convolution.

12. A machine comprising a mandrel for winding thereupon a flat metal strip into consecutive partially overlapping windings to form a volute upon said mandrel having consecutive partially overlapping convolutions; means for holding the forward end of said strip upon said mandrel with said strip inclined to the axis of said mandrel to provide for the pitch of said convolutions during rotation of said mandrel; means for rotating said mandrel; means having a face adapted to engage

said strip throughout its entire width as it is being wound, for pressing against said strip; means for moving said pressing means axially of said mandrel during rotation thereof to maintain said face in engagement with said strip as it is being wound; and means providing a yielding pressure against said pressing means in the direction of said mandrel during said winding.

13. A machine comprising a mandrel for winding thereupon a flat metal strip into consecutive partially overlapping windings to form a volute upon said mandrel having consecutive partially overlapping convolutions; means for holding the forward end of said strip upon said mandrel with said strip inclined to the axis of said mandrel to provide for the pitch of said convolutions during rotation of said mandrel; means having a face adapted to engage said strip throughout its entire width as it is being wound, for pressing against said strip; means providing a yielding pressure against said pressing means in the direction of said mandrel during said winding; means for guiding said strip to said mandrel; and means for rotating said mandrel and for simultaneously moving said guiding means axially of said mandrel to produce said pitch and to simultaneously move said pressing means with said guiding means and at the same speed to maintain said face in engagement with said strip as it is being wound.

HARRY S. PEYTON.