Nov. 15, 1960 R. G. HEAL 2,960,600

HELICAL SPRING FORMING APPARATUS

Filed Aug. 10, 1959 3 Sheets-Sheet 1

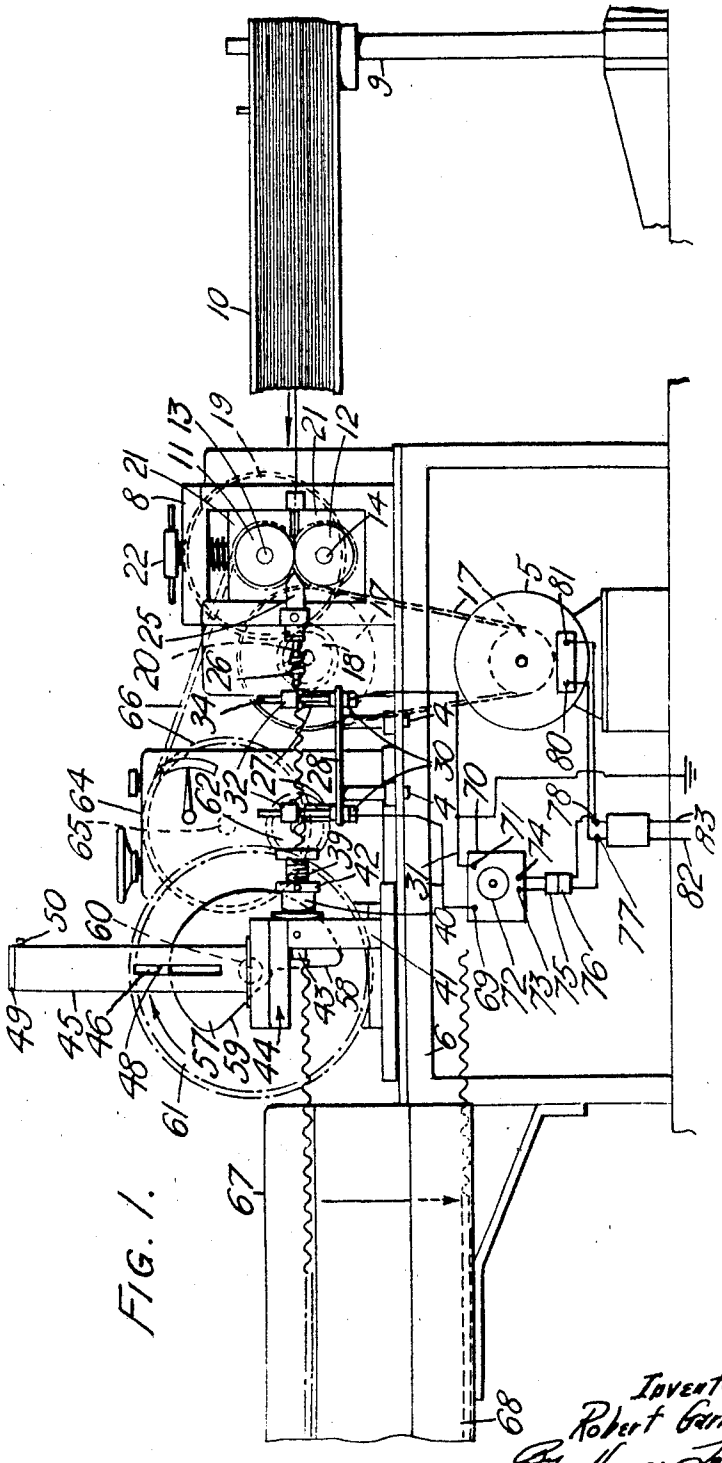


FIG. 1.

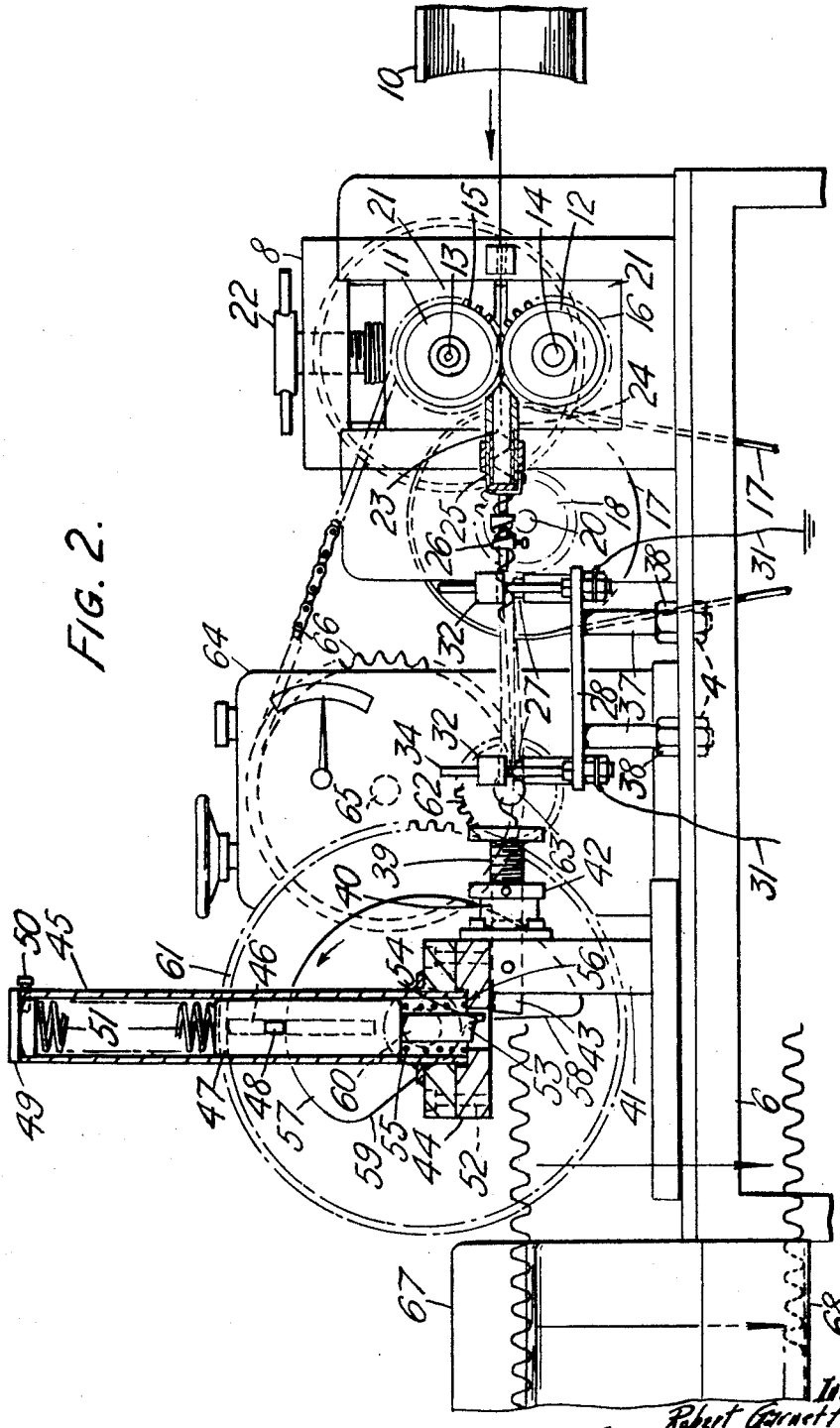
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Nov. 15, 1960 R. G. HEAL 2,960,600

HELICAL SPRING FORMING APPARATUS

Filed Aug. 10, 1959 3 Sheets-Sheet 2

FIG. 2.



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Nov. 15, 1960 R. G. HEAL 2,960,600

HELICAL SPRING FORMING APPARATUS

Filed Aug. 10, 1959 3 Sheets-Sheet 3

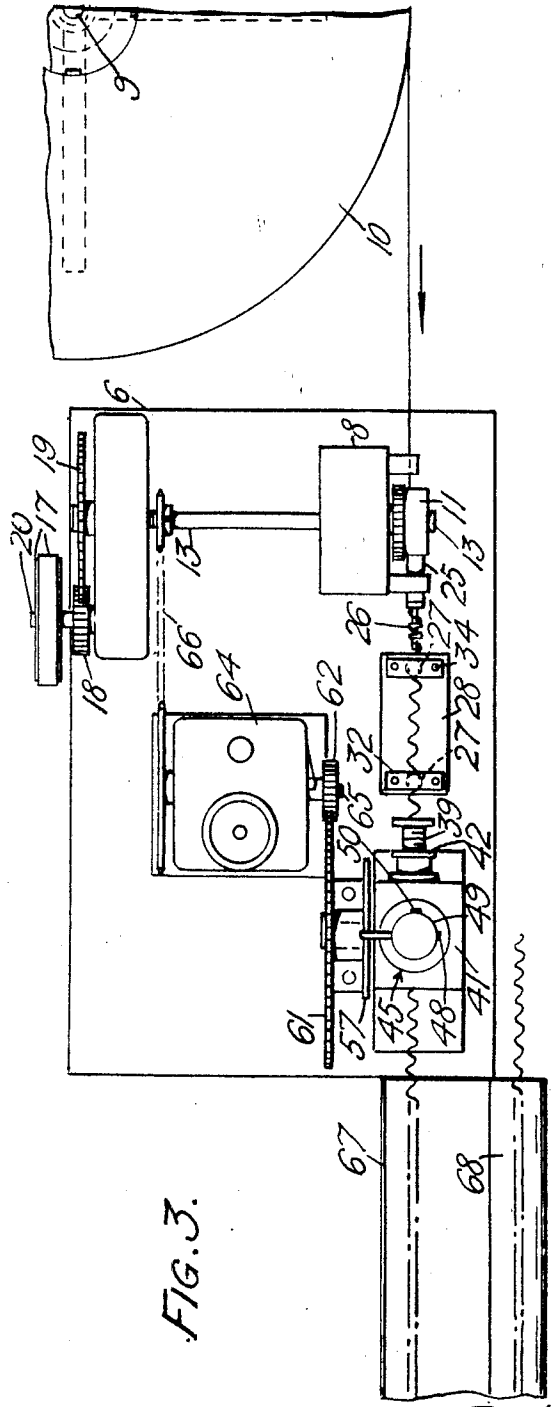


FIG. 3.

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HELICAL SPRING FORMING APPARATUS

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7 Claims. (Cl. 219—153)

This invention relates to spring coiling apparatus and has for an object to provide means whereby a succession of springs of predetermined length may be produced without stopping the machine.

According to this invention an apparatus for forming a succession of springs of predetermined length comprises means for coiling the wire into a helix so that the helix moves axially through the apparatus, a cutting mechanism disposed beyond the coiling mechanism and comprising a cutter reciprocable across the path of axial travel of the formed spring, means for moving the cutter away from the formed spring against the action of an operating spring so as gradually to compress that spring, means for releasing the cutter so that it is forced at high velocity by the operating spring into a cutting position and means for rapidly withdrawing the cutter away from the severed portions of the spring, and a variable speed driving transmission associated with the cutting mechanism whereby the lengths of the formed springs may be varied.

Preferably the means for gradually compressing said operating spring and moving the cutter away from the formed spring comprises a cam having a rapid fall and a gradual rise extending from the bottom to the top of said fall which cam is driven by said variable gear. The said variable gear may be an infinitely variable gear of the friction type. Such a gear may be employed due to the fact that as the operating spring is gradually compressed the gear is not subjected to a sudden load.

The means for retracting the cutter rapidly from the severed portions of the spring may comprise a rebound spring disposed in the path of movement of a member on which the cutter is mounted and the rise of the cam is so shaped as to pick up the member on its rebound on that part of the rise which has moved into position during the cutting and rebounding operation.

The formed spring before it is cut is fed through guide tube or anvil and end face of which cooperates with the cutter in the cutting operation.

The cam may comprise a snail cam mounted to rotate to one side of a cylindrical casing about an axis at right angles to the axis of the cylinder which casing contains said reciprocable member and which member is provided with a peg projecting through an axial slot in the casing and engaging said cam and the control spring and rebound spring are disposed within the casing at opposite ends of the reciprocable member and engaging suitable abutments.

In the case in which the spring being formed is heated by the passage of an electric current through it the aforesaid cam is preferably formed from insulating material and the cutting mechanism is insulated from a member which supports it.

The following is a description of a spring forming apparatus to which the invention is applied reference being made to the accompanying drawings in which:

Figure 1 is a diagrammatic side elevation of the apparatus as a whole;

Figure 2 is a part side elevation and part vertical section through the apparatus on a larger scale; and

Figure 3 is a plan of the apparatus shown in Figure 1.

The apparatus comprises three main units, first a known mechanism for coiling the wire into a helix; second a mechanism for heating the wire after it has been coiled; third a mechanism for cutting the coiled wire into required lengths.

The known mechanism for coiling the wire into a helix comprises a storage reel **10** mounted to rotate about a vertical spindle **9**. The wire is drawn from the reel by two rolls **11**, **12** fixed to two horizontal shafts **13**, **14**, mounted one above the other in a frame work **8** which shafts are geared together by pinions **15**, **16**, fixed to them. The wire passes through a guide **7** on the framework to the rolls. The upper shaft **13** is driven from an electric motor **5** through reduction gearing comprising a belt transmission **17** and intermeshing gear wheels **18** and **19** on the pulley shaft **20** and the shaft **13** respectively. The roll **11** has a circumferential groove to accommodate the wire while the roll **12** is smooth and its shaft **14** is mounted in a bearing **21** which is adjustable towards and away from the other shaft by a screw press **22** whereby the wire may be firmly gripped between the rolls. The wire is fed into a known form of coiling device commonly known as a giraffe which comprises a fixed spindle **23** having a groove **24** formed in it which first extends in an axial direction and then continues as a helix of progressively decreasing pitch. The spindle is encircled by a sleeve **25** fixed to the framework which maintains the wire in the groove and finally the wire coil into a helix issues through a guide **26**. The resulting axially moving and rotating wire helix then extends over two spaced electric contacts **27**. The contacts comprise two copper heads fixed to a plate **28** of insulating material by threaded stems **29** which pass through holes in the plate and receive terminals **30** by which electric leads **31** are secured to them the lead connected to the contact nearer the giraffe is earthed.

The wire helix is maintained in engagement with each contact by a saddle piece **32** which rests on the helix and its under surface is provided with a part cylindrical recess **33** which extends around the helix. Each saddle is provided with two holes one on either side of the channel through which pass two guide rods **34** fixed to the insulating plate **28**.

The insulating plate **28** is adjustable in an up and down direction by being supported on a base **6** by two threaded pillars **37** which pass through holes in the base and receive clamping nuts **4**.

In one arrangement suitable for coiling 18 S.W.G., steel wire into a helix having an outer diameter of ⅜ inch and a pitch of about ⅜ inch the helix is passed at a rate of about 50 feet per minute over the contacts which are spaced apart from five to six inches and the amperage passing through the wire is about 80 amps at a voltage

of 8 volts. If the helix travels at a greater rate, a greater amperage is required for example at 100 feet per minute an amperage of 160 is required.

After being heated the wire helix is passed through the mechanism for cutting it to the required length. This mechanism comprises an externally threaded tubular guide or anvil 39 which passes through an internally threaded socket 40 carried by a bracket 41 mounted on the base 6. A clamping nut 42 is provided for holding the guide 39 in the required position in the socket 40. The end face of the anvil as indicated at 43 is at right angles or nearly at right angles to the axis of the anvil so that there is a slight clearance between it and the cutter when the cutter first approaches it but so that they contact with one another when the cutter reaches the wire. A part 44 of the bracket overhangs the end of the anvil and supports an upwardly extending cylinder 45. The cylinder is formed with a vertical slot 46 and contains a plunger 47 having a peg 48 which projects through the slot to the outside of the cylinder. The upper end of the cylinder is closed by a plug 49 which is retained in position by a screw 50. A compression spring 51 is disposed between the plug 49 and the upper face of the plunger 47. The lower end of the cylinder is provided with a flange which is secured to the upper face of the bracket by screws 52. The lower end 53 of the plunger 47 is reduced to square section and is formed with or has secured thereto a cutter 54. A rebound compression spring 55 encircles the reduced end 53 of the plunger and abuts against the shoulder between the two parts of the plunger and against the bottom of the recess 56 in the bracket. The projecting end of the peg 48 engages the periphery of a snail cam 57 formed from insulating material and having a rapid fall 58 and a rise 59 which extends around the cam from the bottom to the top of the fall. The cam is fixed to a horizontal spindle 60 extending at right angles to the axis of the cylinder 45 and mounted in bearings to one side of the bracket 41. This arrangement of the cutter mechanism enables it to be readily insulated from the rest of the apparatus for which purpose the bracket 41 is electrically insulated from the part 6 of the frame of the apparatus on which it is mounted and is arranged so as to have a small degree of adjustment in a direction towards and away from the giraffe which adjustment may require to be made should springs with different pitches of convolutions require to be formed. The horizontal spindle 60 has fixed to it a comparatively large gear wheel 61 which meshes with a pinion 62 fixed to the output shaft 63 of an infinitely variable gear box 64. The input shaft 65 of the gear box is driven by a chain and sprocket transmission 66 from the aforesaid motor driven upper shaft 13. With this arrangement during the revolution of the cam 57 the peg 48 in moving up the rise 59 compresses the spring 51 up to the time it reaches the top of the fall and during this time the cutter will be above the helical coil which is issuing from the tubular anvil having been heated. The peg 48 then comes opposite the rapid fall 58 and descends rapidly causing the cutter to cut the helix. The shoulder between the two parts of the plunger 47 and 53 will engage the rebound spring 55 withdrawing the cutter rapidly above the oncoming helix and the peg by this time is engaged by the rise 59 of the cam 57 preventing it from again descending. The gradual compression of the spring 51 by reason of the rise of the cam extending from the bottom to the top of the rise is of considerable importance since it prevents any sudden and excessive load being thrown on the driving transmission. This enables an infinitely variable gear of the friction type to be employed allowing changes in the length of the spring to be quickly and accurately made. Furthermore the rapid cutting under the action of the compression spring 51 enables the continuous manufacture of springs without stopping the machine which has heretofore been necessary and also allows electrical heat-treatment of the springs to be carried out continuously and accurately.

The helix as it passes from the anvil is received by an inclined platform 67 and when it is severed it rolls down the platform into a collecting trough 68. The inclined platform may be marked with a scale for the purpose of setting the length of the helix to be severed. The lead 31 from the contact 27 further from the giraffe is connected to one of the terminals 69 of the output of a transformer 70 the other lead 31 and the other output terminal 71 of the transformer being connected to the other contact 27 nearer giraffe and to earth. The input of the transformer is arranged for connection with the usual electric supply means. The transformer is so wound that output can supply 80 amperes at 8 volts and a variable resistance having a control knob 72 is associated with one of the transformer windings whereby the amperage and thus the heating of the spring may be varied. The terminals 73 and 74 of the input are connected through a plug and socket connection 75, 76 to two leads 77, 78 from a double pole motor switch 79 which contacts are also connected to the terminals 80, 81 of the motor 5. The other leads 82, 83 from the motor switch being connected to the mains. With this switch arrangement the motor and heating circuit can be cut in and out simultaneously while the motor can be energised without the heating circuit by removing the plug.

It will be appreciated that various modifications may be made to details of construction without departing from the scope of the invention. For example, as pointed out above, instead of electro-current being supplied to the spring by solid contacts bearing on the convolutions, the spring could be passed through electrically conducting receptacles containing mercury and connected to the mains or the spring could be passed through a high frequency electric field.

I claim:

1. An apparatus for forming a succession of springs of predetermined length comprising means for coiling the wire into a helix so that the helix moves axially through the apparatus, a cutting mechanism disposed beyond the coiling mechanism and comprising a cutter reciprocable across the path of axial travel of the formed spring, means for moving the cutter away from the formed spring against the action of an operating spring so as gradually to compress that spring, means for releasing the cutter so that it is forced at high velocity by the operating spring into a cutter position and means for rapidly withdrawing the cutter away from the severed portions of the spring, and a variable speed driving transmission associated with the cutting mechanism whereby the lengths of the formed springs may be varied.

2. An apparatus according to claim 1 wherein the means for gradually compressing said operating spring and moving the cutter away from the formed spring comprises a cam having a rapid fall and a gradual rise extending from the bottom to the top of said fall which cam is driven by said variable gear.

3. An apparatus according to claim 1 wherein the variable gear is an infinitely variable gear of the friction type.

4. An apparatus according to claim 1 wherein the means for retracting the cutter rapidly from the severed portions of the formed spring comprises a rebound spring disposed in the path of movement of a member on which the cutter is mounted and the rise of the cam is so shaped as to pick up the members on its rebound on that part of the rise which has moved into position during the cutting and rebounding operations.

5. An apparatus according to claim 1 wherein the formed spring before it is cut is fed through a guide tube or anvil an end face of which co-operates with the cutter in cutting operation.

6. A helical spring forming apparatus according to claim 2 wherein said cam comprises a snail cam mounted

to rotate to one side of a cylindrical casing about an axis at right angles to the axis of the cylinder which contains said reciprocable member and which member is provided with a peg projecting through an axial slot in the casing and engaging said cam and wherein the control spring and rebound spring are disposed within the casing at opposite ends of the reciprocable member and engaging suitable abutments.

7. A helical spring forming apparatus according to claim 1 in which said spring is heated by the passage of an electric current through it and wherein the cam is formed from insulating material and the cutting mechanism is insulated from a member which supports it.

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