

PATENT SPECIFICATION (11)

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- (21) Application No. 36642/76 (22) Filed 3 Sept. 1976 (19)
 (31) Convention Application No. 50/105 943 (32) Filed 3 Sept. 1975 in
 (33) Japan (JP)
 (44) Complete Specification published 31 Aug. 1978
 (51) INT. CL.² B23P 21/00
 (52) Index at acceptance
 B3E 10F 14E 8 FB
 B3W 10L4C 10LY 22.55A



(54) APPARATUS FOR MOUNTING TENSION COIL SPRING ONTO ARTICLE

(71) We, HITACHI LTD., a corporation organised under the laws of Japan, of 5-1, 1-chome, Marunouchi, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention is concerned with an apparatus for mounting or fitting a tension coil spring onto an article.

Hitherto, in mounting or fitting of a coil spring exhibiting an extremely small tensile force onto an article, for example, as is the case of mounting of a filament onto a stem of a white light bulb or of a fluorescent lamp, an apparatus has been employed having two fingers adapted to clamp respective ends of the spring to stretch the latter to a predetermined length required for the mounting on the article by shifting one of the fingers along the axial direction of the filament. This apparatus is, however, adoptable only for those springs having extremely small tensile forces, and could not be employed in the mounting of tensile coil springs which are expected to exert certain appreciable tensile forces.

Thus, the mounting of a tension coil spring has relied solely upon inefficient manual operations, and has hindered the adoption of fully automated manufacturing lines for articles incorporating such a tension coil spring.

According to the present invention, there is provided an apparatus for mounting or fitting a tension coil spring having a hook at each end onto an article having hook retainers, the apparatus comprising a pair of means for conveying a tension coil spring supplied to a predetermined supplying position to a predetermined mounting position where, in use, the hooks of the coil spring will engage with restraining portions of the hook retainers of such article, each of said conveying means having an end portion adapted in use to push the hooks of the coil spring onto the respective restraining portions of the hook retainers of the article:

guide means for guiding said pair of conveying means so that the end portions thereof move apart during advance of the conveying means from a separation at the supplying positions equal to the distance between the hooks of such coil spring in its unexpanded state to a separation at the mounting position equal to the distance between the hook retainers of the article and means for restraining the hook ends of the coil spring, while the coil spring is pushed and moved by said conveying means, so that the coil spring is extended and contraction of the coil spring by its tension is prevented until the hooks are held by the hook retainers of such article.

The invention will be further described with reference to the accompanying drawings, in which:—

Figure 1 is a front view of a first embodiment of the present invention with each one of the side plates and the guide plates removed;

Figure 2 is a sectional view taken along the line II-II of Figure 1;

Figure 3 is a sectional view taken along the line III-III of Figure 1;

Figure 4 is a sectional view taken along the line IV-IV of Figure 1;

Figure 5 is a front view of part of a second embodiment of the present invention with one of the side plates removed;

Figure 6 is a sectional view taken along the line VI-VI of Figure 5;

Figure 7 is a front view of part of a third embodiment of the present invention with one of the side plates removed;

Figure 8 is a sectional view taken along the line VIII-VIII of Figure 7.

Referring at first to the first embodiment shown in Figs. 1 to 4 inclusive, two side plates 1, 2 are disposed to oppose to each other with spacers 6 interposed therebetween. At the surface of each side plate facing the other side plate, formed are a pair of guide grooves 4 and a pair of guides 5. The space between two guide grooves is narrower at the position for supplying a tension coil spring 3 and wider at the position for mounting the spring 3, while the

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guides 5 run in parallel with respective guide grooves 4 and project outwardly of the surface. A port 7 is defined by the side plates 1, 2 and by a pair of introduction guides 8 interposed between the side plates, for introducing a first one of the coil springs 3 to the supplying position, the springs being coiled successively in series.

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10 A guide plate 9 is fixed to an end surface of the side plate 1 closer to the supplying position and has a groove 10 communicating with a groove 4 of the side plate 1. The guide plate 9 further has another groove 11 which is disposed in contact with the groove 10. Another guide plate 12 is secured to an end surface of the side plate 2 closer to the supplying position, and has a groove 13 which is in communication with the groove 4 of the side plate 2 and which also in the guide plate 12.

15 On the guide plates 9 and 12 are mounted respective pneumatic cylinders 15, 16. The cylinder 15 has a cylinder rod to one end of which secured is a push rod 17 having a protrusion adapted to engage the guide grooves 4 and its associated groove 10. Thus, the push rod 17 is allowed to slide along the grooves 10, 11, and the guide grooves 4 of both side plates 1 and 2, so as to move or convey one hook end of the tension coil spring 3, which has been introduced into the supplying position, to the mounting position. A groove 18 is formed at the end of the push rod 17. The other cylinder 16 has a cylinder rod connected at its one end to a push rod 19 having a protrusion adapted to be received by the groove 10 and its associated guide groove 4. The push rod 19 thus engages slidably the grooves 13, 14 of the guide plate 12 and the guide grooves 4 of both side plates 1 and 2. The push rod 19 thus slides along these grooves to cut the other hook end of the tension coil spring 3, thereby to separate the latter from subsequent springs, by a cutter 20, and then to move the cut hook end to the mounting position. The push rod 19 also has a groove 21 at its extreme end. An article generally designated at a numeral 22 on which the spring 3 is to be mounted has a movable part 24 and a stationary part 23 pivotally secured to each other by means of a pin 25. The parts 23 and 24 have retaining projections 26 and 27, respectively, for retaining the hook end of the tension coil spring 3.

20 In operation, at first the article 22 to which the tension coil spring 3 is to be secured is set at the mounting position. At the same time suitable feeding means (not shown) is energized to feed the tension coil springs 3 successively formed in series to the supplying position, through the port 7 for introduction. As the first coil 3 of the

tension coil springs is set at the supplying position, the cylinders 15, 16 are energized to extend their push rods 17, 19, respectively. The downward movement of the push rod 19 causes the cutting of the end of the spring 3 thereby to separate the latter from the neighbouring or subsequent spring 3, which cutting is effected by means of a cutter 20 provided at the end of the push rod 19 in cooperation with the guide 8 forming the introduction port 7. The root portions of both hook ends of the separated tension coil spring 3 are forced into respective gaps formed between two opposing protrusions or guides 5 of the side plates 1, 2, by the further downward movements of the push rods 17 and 19, so that both hook ends of the tension coil spring 3 come to be restrained by these guides 5. Still further downward movements of the push rods 17, 19 causes a stretching of the tension coil spring 3 which being restrained at both ends by the guides 5 as the spring 3 is moved downwardly toward the mounting position.

As the spring 3 is displaced to the other end surfaces, i.e. the end surfaces closer to the mounting position, of the side plates 1, 2, the hook ends of the tension coil spring 3 are forced into the retaining projections 26, 27 of the article 22. At this moment, the retaining projections 26 and 27 come to be received by the grooves 18, 21 of the push rods 17, 19, respectively. As the hook ends of the tension coil spring 3 reach the root portions of the hook retaining projections 26, 27, both hook ends are relieved so that the spring 3 is allowed to shrink to be retained by both retaining projections 26, 27. The cylinders 15, 16 are then reversed to pull the push rods 17, 19 up to the waiting position above the supplying position, while the article 22 now carrying the tension coil spring 3 is taken out of the apparatus for subsequent steps of process.

It will be understood that the successive springs 3 are conveniently cut and treated in the manner as described by the repeated actions of the apparatus.

Referring now to the second embodiment shown in Figs. 5 and 6, which differs from the first mentioned embodiment in that supporting means as explained later is provided for supporting a tension coil spring which has been cut or separated prior to the setting at the supplying position, a pair of side plates 31 and 32 are disposed to oppose to each other with spacers 6 interposed therebetween. The side plates 31, 32 have, respectively, a pair of guide grooves 4 and a pair of guides 5, in their surfaces facing each other.

The distance between the guide grooves 4 in each pair is larger as it gets closer to the mounting position, i.e. as it gets far from the supplying position, while the

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guides 5 project into the space or gap between the side plates 31, 32 and run in parallel with the associated guide grooves 4. A pair of grooves 34 are formed in each side plates 31, 32, which grooves 34 being in parallel with the guide grooves 4 at their portions closer to the supplying position and diverge at their other ends, i.e. their ends closer to the mounting position. A port 35 for introducing a tension coil spring 33 is formed in one side plate 31 at a position above the guides 5. Rail means 36 are provided for introducing successive tension coil springs 33 to the port 35, which springs being delivered successively from feeding means omitted in the drawings.

A pair of supporting members 37 for supporting the tension coil spring 33 delivered from the port 35 are disposed between the side plates 31, 32 and are provided with respective projections 38 for catching the hook ends of the springs 33. The supporting members 37 further have, respectively, a pair of pins 39 adapted to be slidably received by the grooves 34 formed in the side plates 31, 32, so as to hold the supporting members 37 facing each other at their sides having the projections 38, between the side plates 31 and 32. A pair of pins 41 are fixed between the side plates 31, 32, which carry one ends of springs 40 which in turn are secured at their other ends to the spring supporting member 37 to bias the latter to one ends of the grooves 34 formed in the side plates 31, 32.

A pair of push rods 17 are provided with respective protrusions adapted to be received by the groove 4 and with respective end grooves 18. The push rods 17 are adapted to be supported and driven in a manner which is same with that of the first embodiment and, therefore, is not mentioned here. An article 22 has a movable member 24 rotatably secured to a stationary member 23, are provided with hook retaining projections 26, 27, respectively.

In operation, the article 22 is placed at the mounting position, while the feeding means (not shown) delivers tension coil springs 33, through the rail means 36, successively. The first tension coil spring 33 is supported by the projections 38 by the supporting means 37, at their respective hook ends.

As the push rods 17 are synchronously moved from the supplying position to the mounting position, by means of a driving unit not shown, they come to co-operate with the projections 38 of the supporting members 37 in catching or fixing the hook ends of the tension coil spring 33, therebetween. Further movement of the push rods 17 cause downward displacement of the tension coil spring 33 resisting to the force exerted by the springs 40, during

which the tension coil spring 33 is pulled and stretched since it is restrained at both of its hooked ends by the guides or projections 5 formed in the side plates 31, 32. The supporting members 37 also move toward the mounting position along the grooves 34 and the projections 38 come out of the guide grooves 4. As the tension coil spring 33 reaches the mounting position, its both hook ends are forced onto the retaining projections 26, 27 of the article 22.

The retaining projections 26, 27 are then received by the grooves 18 formed at the ends of the push rods 17. The tension coil spring 33 is relieved from the restraint as its both hook ends are moves to the root portions of the retaining projections 26, 27, and shrinks to be retained on the article 22. The driving unit is then actuated to retract the push rods 17 to their waiting position. The spring supporting members 37 are returned to their original positions by the springs 40. The article 22 now equipped with the tension coil spring 33 is taken out from the apparatus.

It will be seen that above operation is repeated for the successive supply of tension coil springs 33 which have been separated in advance.

Referring now to Fig. 7, a third embodiment of the invention is shown, which employs a different manner of restraint of the hook ends of the tension coil spring. A pair of side plates 51 and 52 are disposed to oppose to each other with spacers 6 interposed therebetween. The surfaces of the side plates 51, 52 facing each other are provided, respectively, with a pair of guide grooves 4 and a pair of grooves 34. The distance between the guide grooves 4 in each pair is larger at the portion closer to the mounting position than at the portion closer to the supplying position. The grooves 34 are disposed outwardly of the guide grooves 4 and have, respectively, portions closer to the supplying position which run in parallel with the guide grooves 4 and portions closer to the mounting position diverging outwardly.

A port 35 for introducing the tension coil spring 33 is formed in the side plate 51. A pair of spring supporting members 53 are provided with projections 54, respectively, each of which having a groove 55. Each of the spring supporting members 53 carries a pair of pins 39 adapted to be slidably received by the grooves 34 formed in the side plates 51, 52. The spring supporting members 53 are so arranged between the side plates 51, 52 as to face each other at their projections 38. A pair of springs 40 are provided to act between stationary pins 41 and the supporting members 53 so as to bias the latter toward the end of the groove 34 closer to the supplying position.

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Each one of a pair of push rods 56 has a protrusion for engaging the guide groove 4 and a groove 57 at its extreme end. Each push rod 56 further has at its extreme end a slidable pilot pin 58 which is urged by a spring 59 to project outwardly from the extreme end of the push rod 56. The arrangements for supporting and driving the push rods 56 are the same with those of aforementioned embodiments. The article 22 on which the tension coil spring is to be mounted has a movable member 23 rotatably secured to a stationary member 24 through a pin 25. The movable and stationary members 23, 24 are provided with hook retaining projections 26 and 27, respectively.

In operation, the article 22 is placed at the mounting position, while feeding means (not shown) feeds the tension coil springs 33 successively through rail means and through the port 31 to the supplying position. The tension coil spring 33 is then supported by the projections 54 of the spring supporting members 53 at their hook ends.

Then, a driving unit is energized to advance the push rods 56 from the supplying position to the mounting position which causes the pilot pins 58 projecting from the push rods 56 to pass through the hooks of the tension coil spring 33 and to enter the groove 55 formed in respective projections 54 of the spring supporting members 53. Thus, the tension coil spring 33 is restrained at their hook ends by the pilot pins 58. During their movement toward the mounting position, the push rods 56 force the projections 54 and, accordingly, the spring supporting members 53, to move along the grooves 34. As the spring supporting members 53 get closer to the mounting position, the projections 54 are moved out away from the guide groove 4, and the tension coil spring 33 is stretched. As the push rods 56 reaches the mounting position, the pilot pins 58 are pressed into the respective push rods 56 against the biasing force of the spring 59 upon abutting the hook retaining projections 26, 27. The push rods 56 move downwardly until the hook ends come to engage the root portions of the retaining projections 26, 27, where the tension coil spring 33 is allowed to shrink to be retained by the projections 26, 27, i.e. on the article 22.

Then, the driving unit is actuated in the reverse direction to pull the push rods back to the waiting position above the supplying position, for receiving the subsequent tension coil spring 33. At this moment, the pilot pins 58 are allowed to project from the push rods 56 being biased by the springs 59, while the spring supporting members 53 are returned to their initial positions by the

springs 40. The article 22 now equipped with the tension coil spring 33 is then taken out from the apparatus. The successive tension coil springs are treated in the same manner by the repeated action of the apparatus.

WHAT WE CLAIM IS:—

1. An apparatus for mounting or fitting a tension coil spring having a hook at each end onto an article having hook retainers, the apparatus comprising a pair of means for conveying a tension coil spring supplied to a predetermined supplying position to a predetermined mounting position where, in use, the hooks of the coil spring will engage with restraining portions of the hook retainers of such article, each of said conveying means having an end portion adapted in use to push the hooks of the coil spring onto the respective restraining portions of the hook retainers of the article; guide means for guiding said pair of conveying means so that the end portions thereof move apart during advance of the conveying means from a separation at the supplying positions equal to the distance between the hooks of such coil spring in its unexpanded state to a separation at the mounting position equal to the distance between the hook retainers of the article and means for restraining the hook ends of the coil spring, while the coil spring is pushed and moved by said conveying means, so that the coil spring is extended and contraction of the coil spring by its tension is prevented until the hooks are held by the hook retainers of such article.

2. An apparatus according to Claim 1, wherein said conveying means each include a push rod, the push rods being reciprocable in diverging directions from said supplying position to said mounting position, and a guide groove for slidably guiding said push rod, and said restraining means includes a pair of protrusions formed in and parallel to the guide grooves for restraining root portions of the hooks of such tension spring.

3. An apparatus according to Claim 1, wherein said conveying means each include a push rod, the push rods being reciprocable in diverging directions from said supplying position to said mounting position, said guide means includes a pair of guide grooves for slidably guiding said push rods in said diverging directions, and said restraining means includes a pin slidably carried by the end of each of the push rods and biased by a spring to project out of said end of the push rod to engage the hook at one of the ends of the coil spring.

4. An apparatus according to Claim 3, and including means for controlling the posture of the hooks at the ends of the



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Each one of a pair of push rods 56 has a protrusion for engaging the guide groove 4 and a groove 57 at its extreme end. Each push rod 56 further has at its extreme end a slidable pilot pin 58 which is urged by a spring 59 to project outwardly from the extreme end of the push rod 56. The arrangements for supporting and driving the push rods 56 are the same with those of aforementioned embodiments. The article 22 on which the tension coil spring is to be mounted has a movable member 23 rotatably secured to a stationary member 24 through a pin 25. The movable and stationary members 23, 24 are provided with hook retaining projections 26 and 27, respectively.

In operation, the article 22 is placed at the mounting position, while feeding means (not shown) feeds the tension coil springs 33 successively through rail means and through the port 31 to the supplying position. The tension coil spring 33 is then supported by the projections 54 of the spring supporting members 53 at their hook ends.

Then, a driving unit is energized to advance the push rods 56 from the supplying position to the mounting position which causes the pilot pins 58 projecting from the push rods 56 to pass through the hooks of the tension coil spring 33 and to enter the groove 55 formed in respective projections 54 of the spring supporting members 53. Thus, the tension coil spring 33 is restrained at their hook ends by the pilot pins 58. During their movement toward the mounting position, the push rods 56 force the projections 54 and, accordingly, the spring supporting members 53, to move along the grooves 34. As the spring supporting members 53 get closer to the mounting position, the projections 54 are moved out away from the guide groove 4, and the tension coil spring 33 is stretched. As the push rods 56 reaches the mounting position, the pilot pins 58 are pressed into the respective push rods 56 against the biasing force of the spring 59 upon abutting the hook retaining projections 26, 27. The push rods 56 move downwardly until the hook ends come to engage the root portions of the retaining projections 26, 27, where the tension coil spring 33 is allowed to shrink to be retained by the projections 26, 27, i.e. on the article 22.

Then, the driving unit is actuated in the reverse direction to pull the push rods back to the waiting position above the supplying position, for receiving the subsequent tension coil spring 33. At this moment, the pilot pins 58 are allowed to project from the push rods 56 being biased by the springs 59, while the spring supporting members 53 are returned to their initial positions by the

springs 40. The article 22 now equipped with the tension coil spring 33 is then taken out from the apparatus. The successive tension coil springs are treated in the same manner by the repeated action of the apparatus.

WHAT WE CLAIM IS:—

1. An apparatus for mounting or fitting a tension coil spring having a hook at each end onto an article having hook retainers, the apparatus comprising a pair of means for conveying a tension coil spring supplied to a predetermined supplying position to a predetermined mounting position where, in use, the hooks of the coil spring will engage with restraining portions of the hook retainers of such article, each of said conveying means having an end portion adapted in use to push the hooks of the coil spring onto the respective restraining portions of the hook retainers of the article; guide means for guiding said pair of conveying means so that the end portions thereof move apart during advance of the conveying means from a separation at the supplying positions equal to the distance between the hooks of such coil spring in its unexpanded state to a separation at the mounting position equal to the distance between the hook retainers of the article and means for restraining the hook ends of the coil spring, while the coil spring is pushed and moved by said conveying means, so that the coil spring is extended and contraction of the coil spring by its tension is prevented until the hooks are held by the hook retainers of such article.

2. An apparatus according to Claim 1, wherein said conveying means each include a push rod, the push rods being reciprocable in diverging directions from said supplying position to said mounting position, and a guide groove for slidably guiding said push rod, and said restraining means includes a pair of protrusions formed in and parallel to the guide grooves for restraining root portions of the hooks of such tension spring.

3. An apparatus according to Claim 1, wherein said conveying means each include a push rod, the push rods being reciprocable in diverging directions from said supplying position to said mounting position, said guide means includes a pair of guide grooves for slidably guiding said push rods in said diverging directions, and said restraining means includes a pin slidably carried by the end of each of the push rods and biased by a spring to project out of said end of the push rod to engage the hook at one of the ends of the coil spring.

4. An apparatus according to Claim 3, and including means for controlling the posture of the hooks at the ends of the

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coil spring, supplied to said supplying position, to bring them into a predetermined posture.

5. An apparatus according to any one of Claims 1 to 4 and including a cutter for cutting the coil spring from a length of coil spring stock, when in said supplying position.

6. An apparatus according to any one of Claims 1 to 5 wherein said guide means includes a guide plate with a pair of guide grooves, in each of which a respective one of the conveying means is guided, said restraining means comprising two pairs of guide projections, each pair of said guide projections being provided along each guide groove in such a manner that top edges of the respective projections in each pair oppose each other with a clearance therebetween so as to constrain a root portion of the hook at one of the ends of the coil spring.

7. An apparatus according to Claim 6, wherein said plate is vertically disposed, the distance between the guide grooves gradually increasing vertically from the supplying position to the mounting position.

8. An apparatus according to Claim 7, wherein said driving means comprises a pair of cylinders operable to cause the conveying means to be pushed along the guide

grooves from the supplying position to the mounting position, said conveying means each having a respective end face portion which, in use, contacts a hook at one of the ends of the coil spring in which a groove is provided, the groove in the end face portion of each conveying means being arranged so as, in use, to accommodate part of one of the hook retainers of said article.

9. An apparatus for mounting or fitting a tension coil spring onto an article, substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 4 of the accompanying drawings.

10. An apparatus for mounting or fitting a tension coil spring onto an article, substantially as hereinbefore described with reference to and as illustrated in Figures 5 and 6 of the accompanying drawings.

11. An apparatus for mounting or fitting a tension coil spring onto an article, substantially as hereinbefore described with reference to and as illustrated in Figures 7 and 8 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1978
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY
from which copies may be obtained.

