

METHOD AND APPARATUS FOR WINDING A WIRE ON A WORK

BACKGROUND OF THE INVENTION

The present invention relates to a winding apparatus for winding a wire around a deflection yoke frame to obtain a saddle type coil or the like. The present invention also relates to a work winding method therefor.

A conventional deflection yoke frame of a deflection yoke used in a general television receiver has the following structure. Namely, two deflection frame halves are prepared. A vertical coil is wound around one of the deflection frame halves and a horizontal coil is wound around the other of the deflection frame halves. These are assembled to form a deflection coil on a single funnel-like deflection yoke frame. Accordingly, it is relatively easy to wind a saddle type coil or the like on the deflection yoke frame.

However, today, a "high vision" receiver tends to be spread. A deflection yoke frame in the deflection coil of the high vision receiver is originally formed into a one-piece funnel-like shape. For this reason, it suffers from a difficulty in winding the coil. There are various conventional approaches to a structure of a winding devices or a wire winding method to overcome this difficulty.

Fig. 1 is a perspective view showing one example of a deflection yoke frame of the conventional high vision receiver.

A deflection yoke frame 21 shown in Fig. 1 has a generally

funnel-like shape that gradually increases its diameter toward one end. A large opening portion 21a is to be disposed on a fluorescent surface side of a cathode ray tube, and a small opening portion 21b is to be disposed on a neck side of the cathode ray tube.

Also, a plurality of retaining pieces 21c, a plurality of winding grooves 21d and a single opening-portion circumferential groove 21e are provided on the side of the opening portion 21a of the deflection yoke frame 21, whereas a plurality retaining pieces 21f, winding grooves 21g and opening-portion circumferential groove 21 are provided on the side of the opening portion 21b of the deflection yoke frame 21. A wire is wound on an inner circumferential surface of the deflection yoke frame 21 to form a saddle type coil.

Figs. 2 and 3 show an example of winding steps for forming a saddle type coil 9a by winding a wire 9 around the deflection yoke frame 21. The explanation will be made as to the winding operation with reference to Figs. 2 and 3. In Figs. 2 and 3, reference numeral 4 denotes a nozzle unit on the winding device side, and reference numeral 5 denotes a guide unit on the winding device side.

A free end of the wire 9 is first gripped by a nozzle 18 of the nozzle unit 4, the nozzle unit 4 is lowered down to the opening portion 21b through a center of the deflection yoke frame 21, the free end of the wire 9 is clamped by an

entangling unit (not shown) in this position, and the free end is entangled to an entangling portion 21k provided at a predetermined position of the opening portion 21b.

Subsequently, the guide unit 5 is used to pick up the wire 9, and the wire 9 is withdrawn so that the wire 9 is not hooked at the retaining piece 21f when the yoke 21 is rotated. Then, the wire 9 is caused to extend through the groove 21g from one retaining piece 21f to a predetermined retaining piece 21f. The wire 9 is raised through the center of the deflection yoke frame 21 from the retaining piece 21f'. The wire 9 is caused to extend from the retaining piece 21c provided at a predetermined position on the side of the opening portion 21a of the deflection yoke frame 21 to a predetermined retaining piece 21c' through the opening-portion circumferential groove 21e. The wire 9 is lowered through the center of the deflection yoke frame 21 from the retaining piece 21c' and returned back to the retaining piece 21f in order. This is repeated to obtain a predetermined number of windings. Finally, the entangling unit clamps the free end of the wire 9, entangles this to a predetermined entangling portion 21k and cut the wire 9 to form a single saddle type coil 9a. Thus, a plurality of saddle type coils are provided on the inner surface of the deflection yoke frame 21 to form a deflection coil assembly. Incidentally, the detail of the above-described winding method is disclosed in pending US patent application serial No. 08/140,465 herein

incorporated by reference.

By the way, in the structure shown in Figs. 2 and 3, the entangling portions 21k are formed in the deflection yoke frame 21 in advance. However, in some cases, the entangling portions 21k are not formed in advance. In such cases where the independent entangling portions 21k are not provided, the retaining pieces 21c are used also as the entangling portions. In those cases where the wire is entangled to the retaining pieces 21c, the opening-portion circumferential groove 21e would be too narrow to perform a predetermined number of windings.

As described above, in the conventional winding apparatus having such a structure, in the case where the entangling portions are not provided at predetermined positions of the deflection yoke frame 21, a method of entangling the wire 9 at the retaining pieces 21c is used. However, the convention winding apparatus suffers from such a problem that it is impossible to set a predetermined length of the entangled wire 9 because it is necessary to avoid the reduction of an effective width of the opening-portion circumferential groove 21e. In other words, the conventional apparatus suffers from the problems that the wire 9 could be entangled at the retaining pieces 21c only by a length corresponding to two or three turns, and it is impossible to withdraw a length of the wire 9 enough to fix the free end of the wire 9 to a fixed pin

(not shown) located at a predetermined position.

SUMMARY OF THE INVENTION

In view of the above-noted defects, an object of the invention is to provide a wire winding method and apparatus for winding a wire also to a deflection yoke frame having no entangling portions, as desired.

In order to attain this and other objects, there is provided a winding apparatus for winding a wire fed from a winding feeding source to a work, comprising: a nozzle unit to which the wire is fed, the nozzle moving up and down; a guide mechanism for holding the wire introduced from the nozzle unit and for guiding the wire to the work; a work receiving base on which the work is laid; a wire clamp for clamping the wire that has been guided by the guide mechanism; and a rotary portion for rotating the work receiving base, wherein after the wire has been clamped by the wire clamp, the wire is wound on the work in cooperation with a movement of the nozzle unit, a holding operation of the guide mechanism and a rotational operation of the rotary portion.

According to another aspect of the invention, there is provided a winding method for winding a wire fed from a winding feeding source to a work in an winding apparatus, the apparatus comprising: a nozzle unit to which the wire is fed, the nozzle moving up and down; a guide mechanism for holding the wire introduced from the nozzle unit and for guiding the wire to the

work; a work receiving base on which the work is laid; a wire clamp for clamping the wire that has been guided by the guide mechanism; and a rotary portion for rotating the work receiving base, the winding method comprising the following steps of: clamping the wire by the wire clamp; and after the clamping, winding the wire onto the work in cooperation with a movement of the nozzle unit, a holding operation of the guide mechanism and a rotational operation of the rotary portion.

With such an arrangement, even if the entangling pins are not provided on the work, because the wire clamping mechanism is provided on the work receiving base, the wire is clamped by the engagement operation between the nozzle unit and the wire clamping mechanism, and further the coil winding operation of the wire to the work is carried out by the nozzle unit, the work receiving base and the wire guide mechanism in cooperation. Accordingly, even if the entangling pins are not provided in the work, it is possible to wind the wire as desired. The winding precision is enhanced and a winding time may be shortened to enhance the productability or the like.

Also, when the wire is clamped by the above-described clamping mechanism and the wire is wound at the entangling portion provided at a predetermined position of the work, if the guide rollers are provided for guiding the wire along the outer portion of the work, when the coil winding operation of the wire is effected to the work, the wire is tensioned to the

guide rollers provided on the outer peripheral portion of the work receiving base, and the tension may be applied to the wire up to the work winding operational position. Accordingly, it is possible to set the sufficient length of the wire end portion.

Furthermore, it is possible to dispense with the operation of entangling the wire to the work.

In addition, since the winding the work having the entangling portions is carried out by the cooperation of the nozzle unit, the work receiving base and the wire guide mechanism, it is possible to perform the winding operation and entangling operation of the wire also for the work having the entangling portions.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1 is a perspective view showing a conventional deflection yoke frame;

Fig. 2 is an illustration of a conventional winding method;

Fig. 3 is an illustration of the conventional winding operation;

Fig. 4 is a perspective showing an overall structure of a winding apparatus according to the present invention;

Fig. 5 is a perspective view showing a primary part of a winding supply portion of the winding apparatus shown in Fig.

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Fig. 6 is a perspective view showing a primary part of nozzle unit of the winding apparatus shown in Fig. 3;

Fig. 7 is a perspective view showing a primary part of a guide unit of the winding apparatus shown in Fig. 3;

Fig. 8 is an illustration of an operation of the guide unit;

Fig. 9 is an illustration of another operation of the guide unit;

Fig. 10 is a perspective view showing an overall structure of a work receiving base of the winding apparatus shown in Fig. 3;

Fig. 11 is a detailed enlarged perspective view showing a work receiving base in accordance with the present invention;

Fig. 12 is a perspective view showing a peripheral structure of the work receiving base of the winding apparatus of the invention;

Fig. 13 is a perspective view showing a wire clamping mechanism in the winding apparatus of the invention;

Fig. 14 is a view showing an operational state of the wire clamping mechanism of the winding apparatus of the invention;

Fig. 15 is a view showing another operation state of the wire clamping mechanism of the winding apparatus of the invention; and

Fig. 16 is a view showing still another operation state of the wire clamping mechanism of the winding apparatus of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention will now be described in detail with reference to the accompanying drawings.

Fig. 4 is a perspective view showing an overall structure of a winding apparatus according to the present invention. In Fig. 4, the winding apparatus generally includes a winding feeding section 30, a nozzle unit 40, a guide unit 50, a work receiving base 60, a clamping mechanism 70 and the like. Incidentally, the following explanation will be made as to the case where the winding apparatus is used to form a saddle type coil, i.e., a workpiece (hereinafter simply referred to as a work) shown in Fig. 1, by winding the wire 9 around the deflection yoke frame 21. It should be noted that a nozzle 42 of the nozzle unit 40, a guide chip 51 of the guide unit 50 and a centerline α of the work receiving base 60 are included in a single XZ plane.

Fig. 5 is a perspective view showing a primary part structure of the winding feeding section 30. A snail guide 31, guide pulleys 32a, 32b, 32c and 32d, a pulley 33, tension pulleys 34a and 34b and the like are provided in the winding feeding portion.

A wire 9 fed from a winding supply source (not shown) is caused to pass through the snail guide 31 and is introduced into the guide pulley 32a and further introduced from the guide pulley 32a to a pulley 33 of a hysteresis brake. The wire is wound by one turn around the pulley 33 and thereafter is fed to the nozzle unit 40 through the guide pulley 32b, the tension pulley 34a, the guide pulley 32c, the tension pulley 34b and the guide pulley 32d.

Also, coil springs 35 are mounted on the tension pulleys 34a and 34b. The coil springs 35 normally urge the tension pulleys 34a and 34b in a direction that the tension pulleys 34a and 34b are moved in a direction away from the guide pulleys 32c and 32d, respectively, to thereby impart tensions to the wire 9 that passes through the winding feeding section 30.

Fig. 6 is a perspective view showing a primary part structure of the nozzle unit 40. The nozzle unit is composed of a stop housing 41, a nozzle 42, a belt 43, a pulley 44 and the like. A tip portion of the nozzle 42 is composed of a nozzle body 42a, a head socket 42b and a nozzle head 42c. These three components are separatable from each other.

Then, the wire 9 that has passed through the winding supply section 30 is introduced (for example, manually) through the stop housing 41 and the nozzle 42 to the guide unit 50 and is engaged with the guide chip thereof for winding to the work.

Incidentally, the movement of the nozzle 42 along the X

axis (back-and-forth direction) during the winding operation is attained by a rotation of a unit drive screw 46 through the belt 43 and the pulley 44 by a drive of a servo motor (not shown). Namely, the back-and-forth operation of the nozzle 42 is carried out by the feeding operation of the unit drive screw 46. Also, the movement of the nozzle 42 along the Z axis (i.e., up-and-down direction) is carried out by another servo motor (not shown). Also, a rotation of the nozzle during the winding operation is carried out by a drive of a stepping motor 45.

Fig. 7 is a perspective view showing a primary part of the guide unit 50. In Fig. 7, the guide unit 50 is composed of guide chips 51a and 51b, entangling chips 52a and 52b, cylinders 53a, 53b, 54a and 54b, rotary actuators 55a and 55b, a servo motor 56, a pulley 57, a belt 58 and the like. Figs. 8 and 9 show an arrangement of the guide chips 51a and 51b, the entangling chips 52a and 52b, the cylinders 53a, 53b, 54a and 54b, and the rotary actuators 55a and 55b.

In the guide unit 50, the wire 9 that has been introduced through the nozzle 42 is held by the guide chip 51 and the entangling chip 52, and the wire 9 is clamped by the clamping mechanism 70 provided on the work receiving base 60. Thereafter, the wire is engaged with the nozzle 42 and the work receiving base 60 upon the winding operation, thereby carrying out the winding operation to the work 21. After the winding operation, the wire is engaged with the entangling chip 52,

thereby performing the entangling operation to the work 21.

The operation of the guide unit 50 in the X axis direction (back-and-forth direction) is carried out by the drive of the servo motor 56 through the pulley 57 and the belt 58, whereas the operation thereof in the Z axis direction (up-and-down) is carried out by a servo motor, a pulley and a belt (all not shown).

Also, swing motions of the guide chips 51a and 51b are carried out by the cylinders 53a and 53b, and the back-and-forth feeding operations of the entangling chips 52a and 52b are carried out by the cylinders 54a and 54b, respectively. Upon the entangling operation of the wire 9, the guide chips 51a and 51b, the entangling chips 52a and 52b and the cylinders 53a, 53b, 54a and 54b are all rotated by the drive of the rotary actuators 55a and 55b to perform the entangling operation of the wire 9. Figs. 8 and 9 show the state in which the guide chips 51a and 51b, the entangling chips 52a and 52b and the cylinders 53a, 53b, 54a and 54b are all rotated through 180° by the drive of the rotary actuators 55a and 55b. The rotation of the guide mechanism is performed of course in the entangling operation and also in changing the direction for hooking the wire with the guide chips 51a and 51b.

Fig. 10 shows a overall structural perspective view showing the work receiving base 60. Fig. 11 is an enlarged perspective view of a primary part of the work receiving base

60. Fig. 12 is a perspective view showing a peripheral structure of the work receiving base 60.

In Figs. 10, 11 and 12, the work receiving base 60 installed on a table has a work receiving body 61 on which a funnel-like deflection yoke frame 21 (the same deflection yoke frame 21 as shown in Fig. 1) to be a work. A cam 62 is integrally formed with the outer circumference of the work receiving body 61. A sector 63 is engaged with the cam 62 and the pinion 64 in turn is meshed with the sector 63. When the pinion 64 is drivingly rotated, a pressure block 65 for gripping grip portions 21j of the deflection yoke frame 21 is advanced toward the deflection yoke frame 21 along a cam groove 62a of the cam 62 so that it is brought into contact with the deflection yoke frame 21 to thereby grip the grip portions 21j. On the other hand, in synchronism with the gripping operation of the grip portions 21j, the work receiving body 61 that supports the outer circumference on the side of the opening portion outer surface 21a of the deflection yoke frame 21 is also engaged with each groove 62b in the cam 62 so that a plurality of rotary members 61b are slightly raised to thereby hold the opening portion outer surface 21i of the deflection yoke frame 21. Namely, the up-and-down movement of the yoke 21 is limited by the grip portions 21j and the work receiving body 61.

Figs. 13 to 16 show a detailed structure and operation of

the wire clamping mechanism 70 formed on the work receiving base 70. The wire clamping mechanism 70 is operated after the pinion 64 is retracted to release the engagement between the sector gear 63 and the pinion 64. With reference to Figs. 13 to 16, the pinion 64 is reciprocated along the Y axis (in the direction indicated by a double headed arrow A-B in Fig. 11). When the pinion 64 is retracted (in the direction indicated by the arrow B in Fig. 11), it is disengaged from the sector gear 63, whereas it moves forwardly (in the direction indicated by the arrow A in Fig. 11), the pinion 64 is engaged with the sector gear 63.

Subsequently, with respect to the clamping operation of the wire 9 in this case, under the condition that the wire 9 is laid between the nozzle 42 and the guide chip 51 is held as it is, the nozzle unit 40 and the guide unit 50 are forwarded toward the wire clamping mechanism 70 (see Figs. 14 and 15). When the guide chip 51 pushes an arm 73 of the wire clamping mechanism 70, a pin 75 that connects a gear 71 and the arm 73 with each other is moved along an oblong hole 77 formed in the arm 73, and at the same time, the gear 71 is rotated clockwise. Thus, a gear 72 that engages with the gear 71 is rotated counterclockwise so that the wire 9 is inserted in a gap defined between teeth of the gear 71 and teeth of the gear 72 (see Fig. 16).

Next, the servo motor 67 is driven, and the work receiving

body 61 on which the wire clamping mechanism 70 is rotated through a predetermined angle (θ°). When the guide unit 50 is moved rearwardly under the condition that the wire 9 may be released, the guide chip 51 that has pushed the arm 73 is moved rearwardly simultaneously therewith and the arm 73 is returned back to the original position by a spring force of a coil spring 74. Accordingly, the gear 71 and the gear 72 are rotated counterclockwise and clockwise, respectively, and the wire 9 is clamped in the engagement between the gears 71 and 72. While the clamping operation of the wire 9 is carried out, the nozzle 42 is left at the stop position where it has inserted the wire 9.

Subsequently, under the condition that the wire 9 is clamped, the nozzle 42 is engaged with the work receiving body 61 and the adjustment of the orientation of the nozzle 42 is attained in synchronism with the rotation of the work receiving body 61 in order to facilitate the hook of the wire 9 to guide rollers 69 provided on the outer peripheral portion of the work receiving body 61. The wire 9 is moved to a wire winding position of the deflection yoke frame 21. Thus, the wire 9 is moved from the clamped position of the wire to the wire winding position through the guide rollers 69, so that a length of the free end portion of the wire 9 may be sufficient.

Also, when the wire is arranged in the wire winding position, the winding of the wire 9 is performed to the

deflection yoke frame 21. In the winding of the wire 9 to the deflection yoke frame 21, first of all, the nozzle 42 is moved to the center of the large diameter portion 21a of the deflection yoke frame 21. Subsequently, the nozzle 42 is moved downwardly along the Z axis (up-and-down direction) and winds the wire 9 along curved winding grooves 21d of the deflection yoke frame 21. Subsequently, the wire 9 that has reached the small diameter portion 21b is entangled by the guide chip 51b, and the wire is wound along the opening-portion circumferential winding groove 21h in cooperation with the rotation of the work receiving body 61. The guide chip 51b releases the wire 9 at a predetermined small diameter portion 21b. Then, the nozzle 42 is moved upwardly along the Z axis and the wire is entangled at the guide chip 51a. the winding of the wire 9 is carried out in cooperation with the rotation of the work receiving base 61 up to a predetermined winding groove 21d along the opening portion circumferential groove 21e of the large diameter portion 21a. Thereafter, the wire is released, and again, the nozzle 42 is lowered along the Z axis to repeatedly perform the winding of the wire 9 around the deflection yoke frame 21.

After the completion of the winding of the wire 9 on the deflection yoke frame 21, a cut clamp (not shown) is forwarded toward the wire 9 laid between the guide chip 51a and the nozzle 42 to thereby cut and clamp the wire 9.

As described above, according to the work winding method

and apparatus according to the present invention, even if the entangling pins are not provided on the work, because the wire clamping mechanism is provided on the work receiving base, the wire is clamped by the engagement operation between the nozzle unit and the wire clamping mechanism, and further the coil winding operation of the wire to the work is carried out by the nozzle unit, the work receiving base and the wire guide mechanism in cooperation. Accordingly, even if the entangling pins are not provided in the work, it is possible to wind the wire as desired. The winding precision is enhanced and a winding time may be shortened to enhance the productability or the like.

Also, when the wire is clamped by the above-described clamping mechanism and the wire is wound at the entangling portion provided at a predetermined position of the work, if the guide rollers are provided for guiding the wire along the outer portion of the work, when the coil winding operation of the wire is effected to the work, the wire is tensioned to the guide rollers provided on the outer peripheral portion of the work receiving base, and the tension may be applied to the wire up to the work winding operational position. Accordingly, it is possible to set the sufficient length of the wire end portion.

Various details of the invention may be changed without departing from its spirit nor its scope. Furthermore, the foregoing description of the embodiments according to the

present invention is provided for the purpose of illustration only, and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.



WHAT WE CLAIM IS:

1. A winding apparatus for winding a wire fed from a winding feeding source to a work, comprising:

a nozzle unit to which the wire is fed, said nozzle moving up and down;

a guide mechanism for holding the wire introduced from said nozzle unit and for guiding the wire to the work;

a work receiving base on which the work is laid;

a wire clamp for clamping the wire that has been guided by said guide mechanism; and

a rotary portion for rotating the work receiving base, wherein after the wire has been clamped by said wire clamp, the wire is wound on the work in cooperation with a movement of said nozzle unit, a holding operation of said guide mechanism and a rotational operation of said rotary portion.

2. The apparatus according to claim 1, wherein a nozzle tip end portion of said nozzle unit comprises a nozzle body, a head socket and nozzle head.

3. The apparatus according to claim 2, further comprising nozzle rotating means for rotating said nozzle tip end portion.

4. The apparatus according to claim 1, wherein said guide mechanism comprises a guide chip for hooking the wire and guiding the wire in a predetermined direction, and an entangling chip for holding the wire that has been hooked by said guide chip.



5. The apparatus according to claim 4, further comprising actuating means for actuating said guide mechanism, wherein said actuating means comprises a first cylinder for swinging said guide mechanism and a second cylinder for feeding said entangling chip back and forth.

6. The apparatus according to claim 5, wherein said actuating means further comprises a rotary actuator for rotating said guide mechanism as a whole.

7. The apparatus according to claim 1, further comprising a work holding mechanism for fixing the work to said work receiving base.

8. The apparatus according to claim 7, wherein said work holding means includes a cam provided on said work receiving base, a sector gear engageable with said cam, a drivingly rotated pinion, and a pressure block for gripping the work by an engagement among said cam, said sector gear and said pinion.

9. The apparatus according to claim 8, further comprising an actuator for engaging said pinion and said sector gear with each other and forwarding and retracting said pinion for releasing the engagement between said pinion and said sector.

10. The apparatus according to claim 1, further comprising a plurality of guide rollers for guiding the wire from said wire clamp to a wire winding position of the work.

11. The apparatus according to claim 10, wherein said plurality of wire guide rollers are disposed around an outer



circumferential peripheral portion of said work receiving base.

12. The apparatus according to claim 11, wherein said wire clamp is composed of a plurality of gears that engage with each other so that the wire may be inserted and clamped between said plurality gears.

13. A winding method for winding a wire fed from a winding feeding source to a work in an winding apparatus, said apparatus comprising: a nozzle unit to which the wire is fed, said nozzle moving up and down; a guide mechanism for holding the wire introduced from said nozzle unit and for guiding the wire to the work; a work receiving base on which the work is laid; a wire clamp for clamping the wire that has been guided by said guide mechanism; and a rotary portion for rotating the work receiving base,

said winding method comprising the following steps of:

clamping the wire by said wire clamp; and

after said clamping, winding the wire onto the work in cooperation with a movement of said nozzle unit, a holding operation of said guide mechanism and a rotational operation of said rotary portion.

14. The method according to claim 13, further comprising the steps of:

hooking the wire and guiding the wire in a predetermined direction by a guide chip provided on said guide mechanism; and

holding, by an entangling chip provided on said guide



mechanism, the wire that has been hooked by said guide chip.

15. The method according to claim 14, further comprising the steps of:

swinging said guide mechanism;
feeding said entangling chip back and forth; and
rotating said guide mechanism as a whole.

16. The method according to claim 13, further comprising the step of: fixing the work to said work receiving base.

17. The method according to claim 16, wherein said work holding means includes a cam provided on said work receiving base, a sector gear engageable with said cam, a drivingly rotated pinion, and a pressure block for gripping the work by an engagement among said cam, said sector gear and said pinion, and said method comprising the steps of:

engaging said pinion and said sector gear with each other;
and

forwarding and retracting said pinion for releasing the engagement between said pinion and said sector.

18. The method according to claim 13, further comprising the step of using a plurality of guide rollers for guiding the wire from said wire clamp to a wire winding position of the work.

19. The method according to claim 18, wherein said plurality of wire guide rollers are disposed around an outer circumferential peripheral portion of said work receiving base.



20. The method according to claim 19, wherein said wire clamp is composed of a plurality of gears that engage with each other so that the wire may be inserted and clamped between said plurality gears.