METHODS AND APPARATUS FOR CONTINUOUS WINDING OF SPOOLs AND PRODUCTS MADE THEREFROM

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Filed: Mar. 4, 2010

ABSTRACT
A method of winding a wire about a plurality of spools is provided. The method includes locating the plurality of spools on a winding shaft in a side-by-side fashion. An adaptor plate is located between adjacent spools. The adaptor plate includes a wire catch feature configured for catching the wire as a traveler feeding the wire to the spools moves from one spool to the next spool while the winding shaft rotates.
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TECHNICAL FIELD

[0001] The present specification generally relates to methods and apparatus for continuous winding of multiple spools and products made therefrom.

BACKGROUND

[0002] In a conventional spool winding process, a spool may be wound by placing it on a winding shaft of a winding machine. An operator may initiate the winding operation by inserting a bent starting end of the wire into an opening in a drum of the spool and start automatically rotating the winding shaft. A traveler may be used to guide the wire back and forth along the length of the spool until a predetermined amount of wire is wound onto the spool. Afterwards, the winding rod slows and stops rotating and the wire may be cut thereby providing a terminal end for the wire of the spool and a starting end for a subsequent spool. The process may then be repeated for the subsequent spool.

[0003] As may be appreciated, there may be stoppage time between the winding of each spool. Additionally, the winding shaft may increase in rotation speed at the beginning of the winding process then decrease rotation speed at the end of the winding process for each spool. Accordingly, a continuous winding process for a series of spools is desirable.

SUMMARY

[0004] In one embodiment, a method of winding a wire about a plurality of spools is provided. The method includes locating the plurality of spools on a winding shaft in a side-by-side fashion. An adaptor plate is located between adjacent spools. The adapter plate includes a wire catch feature configured for catching the wire as a traveler feeding the wire to the spools moves from one spool to the next spool while the winding shaft rotates.

[0005] In another embodiment, a wire winding assembly for winding wire onto a plurality of spools includes a first spool located on a winding shaft and a second spool located on the winding shaft. An adaptor plate is located between the first spool and the second spool. The adaptor plate includes a wire catch feature configured for catching the wire as a traveler feeding the wire to the first and second spools moves from the first spool to the second spool.

[0006] In another embodiment, a metal welding wire product includes a spool including a core, a first spool flange at one end of the core and a second spool flange at an opposite end of the core. A metal welding wire is wound about the core forming windings. The metal welding wire includes a starting end and a terminating end. Both of the starting end and the terminating end of the welding wire are located outside the windings.

[0007] These and additional features provided by the embodiments described herein will be more fully understood in view of the following detailed description, in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The embodiments set forth in the drawings are illustrative and exemplary in nature and not intended to limit the subject matter defined by the claims. The following detailed description of the illustrative embodiments can be understood when read in conjunction with the following drawings, where like structure is indicated with like reference numerals and in which:

[0009] FIG. 1 is a perspective view of a wire winding apparatus according to one or more embodiments shown and described herein;

[0010] FIG. 2 is a perspective view of a spool for use in the winding apparatus of FIG. 1 according to one or more embodiments shown and described herein;

[0011] FIG. 3 is a side view of an adaptor plate for use in the winding apparatus of FIG. 1 according to one or more embodiments shown and described herein;

[0012] FIG. 4 is another perspective view of the wire winding apparatus of FIG. 1 according to one or more embodiments shown and described herein;

[0013] FIG. 5 is a perspective view of a spool wound with wire according to one or more embodiments shown and described herein;

[0014] FIG. 6 is a perspective view of another spool wound with wire according to one or more embodiments shown and described herein;

[0015] FIG. 7 is a perspective view of a spool wound with wire having one or more of the ends of the wire affixed to the spool according to one or more embodiments shown and described herein;

[0016] FIG. 8 is a perspective view of another spool wound with wire having one or more of the ends of the wire affixed to the spool according to one or more embodiments shown and described herein;

[0017] FIG. 9 is a perspective view of another spool wound with wire having one or more of the ends of the wire affixed to the spool according to one or more embodiments shown and described herein;

[0018] FIG. 10 is a perspective view of another spool wound with wire having one or more of the ends of the wire affixed to the spool according to one or more embodiments shown and described herein;

[0019] FIG. 11 illustrates another embodiment of an adaptor plate.

DETAILED DESCRIPTION

[0020] Embodiments described herein relate generally to methods and apparatus for continuous winding of multiple spools with wire and products produced therefrom. A continuous process is provided for winding a series of spools where the wire automatically “jumps” from spool-to-spool without any need for stopping or even slowing down the winding process between adjacent spools. As will be appreciated, such a continuous winding process can reduce stoppage time and increase efficiency when winding multiple spools with wire.

[0021] Referring to FIG. 1, a winding apparatus 10 generally includes a winding shaft 12, a motor for use in rotating the winding shaft 12 about its elongated axis and a traveler 16 that is used to guide a continuous wire 18 to a plurality of spools 20, 22 and 24. In some embodiments, the wire 18 may be a welding wire, such as a flux cored wire commercially available from Kiswel, Inc. A second motor may be provided for moving the traveler 16 horizontally (or some direction other than horizontal) along a length of a threaded guide rod 28. Adaptor plates 30 and 32 are located between adjacent spools 20, 22 and 24. A clamping wheel 34 is used to clamp the assembly of the spools 20, 22 and 24 and adaptor plates 30.
and 32 together on the winding shaft 12 so that the assembly rotates with the winding shaft 12 during a wire winding operation. As will be described in greater detail below, the adaptor plates 30 and 32 each include catch features that facilitate the jumping of the wire from one spool to the next spool.

[0022] Referring to FIG. 2, the spool 20 includes a core 34 and a first spool flange 36 and a second spool flange 38 at opposite sides of the core 34. A shaft receiving opening 44 extends through the spool 20 for receiving the winding shaft 12. The first and second spool flanges 36 and 38 extend radially outwardly from the core 34 such that a width $W_1$ of the first and second spool flanges 36 and 38 is greater than a width $W_2$ of the core 34. In some embodiments, an opening 40 is provided at the core 34, for example, for receiving a starting end of the wire. Openings 42 may also be provided through the first and second spool flanges 36 and 38 to receive a terminating end of the wire once the wire is wound about the core 34. In some embodiments, the spools 20, 22 and 24 are all substantially the same in their configuration, however, they may be different.

[0023] Referring now to FIG. 3, the adaptor plate 30 includes a shaft receiving opening 46 for receiving the winding shaft 12. Wire catching features in the form of notches 48 extend inwardly from an outer periphery 50 of the adaptor plate 30. While the notches are illustrated as being U-shaped, they may be any suitable shape for catching the wire, such as V-shaped. The notches 48 are separated from each other by catch arms 52. In some embodiments, the width $W_3$ of the adaptor plate 30 measured between ends of opposite catch arms 52 is greater than the width $W_1$ of the first and second spool flanges 36 and 38. In some embodiments, $W_3$ is at least about five percent wider than $W_1$ such as at least about eight percent wider than $W_1$. In some embodiments, the adaptor plates 30 and 32 are both substantially the same in their configuration, however, they may be different.

[0024] Referring back to FIG. 1, in operation, an operator bends a starting end of the wire 18 and inserts the starting end into the opening 40 at the core 34 of spool 20 (FIG. 2). The winding apparatus 10 is activated and a controller is programmed to begin rotating the winding shaft 12 and assembly of spools 20, 22, 24 and adaptor plates 30, 32. As the winding shaft 12 rotates, the traveler 16 moves horizontally back and forth in the direction of arrow 54 along the length of the core 34 of the spool 20 so that the wire 18 is wound evenly about the core 34 of the spool 20. Once a predetermined amount of wire 18 is wound about the spool 20, the controller may cause the winding shaft to decelerate to a relatively low speed to complete winding wire about the spool 20, and continue at a low speed as the traveler 16 moves over to the next spool 22. Then, the controller may again accelerate the winding shaft 12 to the relatively high rotational speed as the wire is wound about the spool 22. In another embodiment, winding shaft 12 may maintain its relatively high rotational speed as the traveler moves from the spool 20 to the spool 22. The acceleration process may be repeated for any subsequent spools.

[0025] Once the winding shaft 12 stops rotating, the wire 18 may be cut at the portions 18a and 18b thereby forming a starting end for the spools 22 and 24 and a terminating end for the spools 20 and 22. FIG. 5 illustrates spools 20 and 24. FIG. 6 illustrates spool 22 once separated from the winding shaft 12. As can be seen by FIG. 5, the starting end of the wire 18 of spool 20 is hidden beneath the wire coils since the starting end was inserted in the opening 40 at the core 34 of the spool 20. Referring to FIG. 6, the starting end 60 and the terminating end 62 of the spool 22 are both exposed beyond the outermost windings of the wire 18. In some embodiments, the wire 18 leading to the terminating end 62 extends along the spool flange 36 surface 64, between the spool flange surface 64 and an outermost winding 66.

[0026] In some embodiments, the controller of the winding apparatus 10 may be programmed to control the rotational speed and acceleration of the winding shaft 12 during the winding operation. For example, at the beginning of the winding process when winding the spool 20, the winding shaft 12 may rotate at a relatively low speed and then accelerate at a selected rate to a relatively high speed. In some embodiments, once a predetermined amount of wire 18 is wound about the spool 20, the controller may cause the winding shaft to decelerate to a relatively low speed to complete winding wire about the spool 20, and continue at the low speed as the traveler 16 moves over to the next spool 22. Then, the controller may again accelerate the winding shaft 12 to the relatively high rotational speed as the wire is wound about the spool 22. In another embodiment, winding shaft 12 may maintain its relatively high rotational speed as the traveler moves from the spool 20 to the spool 22. The acceleration process may be repeated for any subsequent spools.

[0027] Referring now to FIGS. 7-10, it may be desirable to affix the free terminating end 60 and/or the free starting end 60 at a location on the spool 20, 22, 24. In some embodiments, the free starting end 60 is affixed to the spool flange 36 at a location outside of the windings. Referring to FIG. 7, the starting end 60 of the wire 18 is illustrated wrapped around an outer edge 68 of the first spool flange 36 and inserted within the opening 42. Referring to FIG. 8, the starting end 60 of the wire 18 is illustrated adhered to an outer surface 70 of the first spool flange 36 with the wire extending over the outer edge 68. An adhesive label 72 may be used to adhere the starting end 60 of the wire 18 at the illustrated location. In some embodiments, a groove 75 may be formed in the periphery of the first spool flange 36 and/or the second spool flange 38 into which the wire 18 may be inserted, for example, such that the wire 18 is seated lower than the periphery of the first spool flange 36 and/or the second spool flange. The groove 75 may be any suitable shape, such as U-shaped, V-shaped, etc. Referring to FIG. 9, in another embodiment, the starting end 60 and/or terminating end 62 may be mechanically affixed to the first and/or second spool flange 36, 38 such as by punching. Referring to FIG. 10, in another embodiment, the starting end 60 and/or terminating end 62 may be affixed to the first and/or second spool flange 36, 38 by electric heat.

[0028] Referring to FIG. 11, an alternative adaptor plate 80 is illustrated with wire catch features 82 and 84 extending outwardly from an edge 86 of the adaptor plate 80.
The above-described winding process and apparatus provides continuous winding of a series of spools on the same winding shaft where the wire automatically jumps from spool-to-spool without any need for stopping or even slowing down the winding process between adjacent spools. Such a continuous winding process can reduce stoppage time and increase efficiency when winding multiple spools with wire. In some embodiments, the continuous winding can provide an increase of about 30 to 40 percent in productivity over other winding processes where stoppage time is needed between spools.

While particular embodiments have been illustrated and described herein, it should be understood that various other changes and modifications may be made without departing from the spirit and scope of the claimed subject matter. Moreover, although various aspects of the claimed subject matter have been described herein, such aspects need not be utilized in combination. It is therefore intended that the appended claims cover all such changes and modifications that are within the scope of the claimed subject matter.

What is claimed is:

1. A method of winding a wire about a plurality of spools, the method comprising:
   locating the plurality of spools on a winding shaft in a side-by-side fashion; and
   locating an adaptor plate between adjacent spools, the adaptor plate including a wire catch feature configured for catching the wire as a traveler feeding the wire to the spools moves from one spool to the next spool while the winding shaft rotates.

2. The method of claim 1, wherein the wire is a welding wire.

3. The method of claim 1, wherein the step of locating the plurality of spools on the winding shaft includes locating at least three spools on the winding shaft in a side-by-side fashion.

4. The method of claim 3, wherein the step of locating the adaptor plate between adjacent spools includes locating a first adaptor plate between adjacent spools and locating a second adaptor plate between adjacent spools, the first and second adaptor plates each including a plurality of notches extending inwardly from an outer periphery of each of the first and second adaptor plates for catching the wire as the traveler feeding the wire to the spools moves between adjacent spools.

5. The method of claim 1 further comprising severing the wire between adjacent spools thereby forming a terminating end for the one spool and a starting end for the next spool.

6. The method of claim 5 further comprising affixing the starting end of the wire to the next spool to a first spool flange of the next spool after the next spool is wound with the wire.

7. The method of claim 6 further comprising affixing a terminating end of the wire to a second spool flange of the next spool after the next spool is wound with the wire.

8. The method of claim 7, wherein at least one of the starting end and the terminating end of the wire is affixed by electric heat to the respective first or second spool flange.

9. The method of claim 7, wherein at least one of the starting end and the terminating end of the wire is affixed to the first or second spool flange by inserting the at least one of the starting end and the terminating end of the wire into an opening through the respective first or second spool flange.

The method of claim 7, wherein at least one of the starting end and the terminating end of the wire is affixed by punching the at least one of the starting end and the terminating end of the wire into a respective first or second spool flange.

11. A wire winding assembly for winding wire onto a plurality of spools, the assembly comprising:
   a first spool located on a winding shaft;
   a second spool located on the winding shaft; and
   an adaptor plate located between the first spool and the second spool, the adaptor plate including a wire catch feature configured for catching the wire as a traveler feeding the wire to the first and second spools moves from the first spool to the second spool.

12. The assembly of claim 11, wherein the wire is a welding wire.

13. The assembly of claim 11 further comprising:
   a third spool located on the winding shaft; and
   a second adaptor plate located between the second spool and the third spool, the second adaptor plate including a notch extending inwardly from an outer periphery of the second adaptor plate for catching the wire as the traveler feeding the wire to the first, second and third spools moves from the second spool to the third spool.

14. A metal welding wire product, comprising:
   a spool including a core, a first spool flange at one end of the core and a second spool flange at an opposite end of the core; and
   a metal welding wire wound about the core forming windings, the metal welding wire including a starting end and a terminating end,
   wherein both the starting end and the terminating end of the welding wire are located outside the windings.

15. The product of claim 14, wherein the starting end of the wire is affixed to the first spool flange.

16. The product of claim 15, wherein the terminating end of the wire is affixed to the second spool flange.

17. The product of claim 16, wherein at least one of the starting end and the terminating end of the wire is affixed by electric heat to the respective first or second spool flange.

18. The product of claim 16, wherein at least one of the starting end and the terminating end of the wire is affixed to the first or second spool flange by inserting the at least one of the starting end and the terminating end of the wire into an opening through the respective first or second spool flange.

19. The product of claim 16, wherein at least one of the starting end and the terminating end of the wire is affixed by punching the at least one of the starting end and the terminating end of the wire into a groove extending inwardly from a periphery of the respective first or second spool flange.

20. The product of claim 14, wherein at least one of the starting end and the terminating end of the wire is affixed to the first or second spool flange by inserting the at least one of the starting end and the terminating end of the wire into a groove extending inwardly from a periphery of the respective first or second spool flange.

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