

WIRE ROPE SLING AND METHOD OF MANUFACTURING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a wire rope sling, and more particularly, to a wire rope sling which allows a reinforcing member to be molded at a work site without any carrying work for lifting up and down a wire rope one by one with a crane and also the reinforcing member to keep its fixing state without departing or separating from a fastener when the reinforcing member is molded on the metallic fastener, and a method of manufacturing the same.

2. Description of the Related Art

As well known in the art, a wire rope sling is used in the loading and unloading work for lifting up and down a heavy article such as freight with a crane. Fig. 12 is a perspective view showing an example of a conventional wire rope sling, and Fig. 13 is a sectional view showing another example of a conventional wire rope sling.

The conventional wire rope sling shown in Fig. 12 has eyes, or rings, at both ends of a wire rope such that the eyes may be caught to a hook, which is disclosed in Korean Patent Registration No. 0854654 (published on August 27, 2008), entitled “Wire rope sling, and device and method for manufacturing the same.” In the configuration of the wire rope sling, at least one end of a wire rope 100 is formed with a ring 100c and equipped with a metallic fastener 110 to fix portions of the wire rope 100 that are overlapped while forming the ring 100c. A reinforcing member 120 is installed to at least one of both sides of the fastener 110 of the wire rope 100, wherein the reinforcing member 120 is installed by insert injection molding in order to be compressed and fixed on the wire rope 100 and has a tapered structure to overcome a step between the fastener 110 and the wire rope 100 through a gentle slope.

Also, the wire rope sling is manufactured through a first step of preparing a wire rope 100 with a predetermined length; a second step of bending both ends of the

wire rope 100 into a ring shape and then fixing overlapped portions with fasteners 110 to form rings 100c; a third step of fixing the wire rope 100 so that a portion of the wire rope 100 where a reinforcing member 120 is to be molded is located in a mold; a fourth step of extruding and injecting a material for molding the reinforcing member 120 into the mold to permeate between the wire rope and a rope and then cooling the molding material; and a fifth step of separating from the mold the wire rope 100 where the reinforcing member 120 is molded beside the fastener 110.

The conventional wire rope sling shown in Fig. 13 has a common ring shape and is used in connection between cords that bind a hook of a crane and freights. In order to form the wire rope into a ring shape, both ends of the rope are compressed and fixed on each other by means of a fastener or the like. However, the rope cannot ensure a firm and stable rope connection since only the fastener is used for fixing the connected portion of the wire rope ring. In order to solve such a problem, Korean Patent Registration No. 823546 (published on April 21, 2008), entitled “Wire rope ring for cargo-working and method for manufacturing the same,” was suggested.

Such a conventional wire rope sling includes a wire rope 100 arranged in a ring structure and located so that its ends are overlapped; a plurality of metallic fasteners 110 and 111 compressed and fixed on the overlapped portion of the wire rope 100 at certain intervals to connect the wire rope 100 into a ring structure; and a reinforcing member 113 compression-molded of a synthetic resin at the overlapped portion of the wire rope 100 between the plurality of fasteners 110 and 111 and at the outsides of the fasteners 110 and 111, wherein the reinforcing member 113 includes a first member 113a having a cylindrical structure and located between the plurality of fasteners 110 and 111 and second members 113b having a tapered structure and located to enclose ends of the overlapped portion of the wire rope 110 at the outsides of the fasteners 110 and 111 not between the fasteners 110 and 111, each of the fasteners 110 and 111 further includes an uneven portion 112, and the first member 113a is made of a hard synthetic resin while the second member 113b is made of a soft synthetic resin.

Also, a method of manufacturing such a conventional wire rope sling includes steps of arranging the wire rope 100 in a ring structure such that both ends of the wire rope 100 are overlapped; compressing a plurality of fasteners 110 and 111 on the overlapped portion of the wire rope 100 to fix them; placing in an injection mold the

connected portion of the wire rope 100 having the plurality of fasteners 110 and 111 compressed thereon; compression-molding the reinforcing member 113 at the overlapped portion of the wire rope 100 between the plurality of fasteners 110 and 111 and outside of the fasteners 110 and 111; and cooling the reinforcing member 113.

Meanwhile, the reinforcing member 120 and the second member 113b are formed in a tapered structure in order to prevent interference with a surrounding object, and this tapered structure is already known in the art before the filing date of this application, for example in Japanese Utility Model Registration No. 3,054,614 (registered on September 24, 1998) and Japanese Patent Publication No. 1994-115853 (published on April 26, 1994).

However, this conventional wire rope sling needs a long working time due to complicated works for lifting heavy wire ropes one by one with a crane, moving the wire ropes toward an injection molding machine after the fastener compression process, setting the wire rope to the injection molding machine and performing injection molding, and then lifting up the insert injection-molded wire rope with the crane, which deteriorates workability and productivity. In addition, a large-sized expensive injection molding machine should be purchased and used, which increases costs and deteriorates economic feasibility, so the above conventional technique is not substantially applicable due to the bad price competitiveness. Moreover, a space for installing the injection molding machine should be ensured, which causes inefficiency in spatial utilization.

SUMMARY OF THE INVENTION

The present invention is conceived to solve the aforementioned problems in the prior art. An object of the present invention is to provide a wire rope sling which allows a reinforcing member to be molded at a work site without any carrying work for lifting up and down a wire rope one by one with a crane and also the reinforcing member to keep its fixing state without departing or separating from a fastener when the reinforcing member is molded on the metallic fastener, and a method of manufacturing the same.

According to an aspect of the present invention for achieving the objects, there

is provided a wire rope sling, wherein rings are respectively formed using both rope ends of a wire rope, the rope end overlapped to a rope body is compressed and fixed on the rope body by a metallic fastener, and an exposed portion of the rope end exposed from the fastener is protected by a reinforcing member integrally formed around an outer periphery of an end of the fastener using a jig.

According to another aspect of the present invention, there is also provided a wire rope sling, wherein a wire rope is formed in a ring shape so that a first rope end and a second rope end of the wire rope overlapped with each other are compressed and fixed on each other by a first metallic fastener and a second metallic fastener, each exposed portion of the first rope end and the second rope end exposed from the first fastener and the second fastener is protected by a reinforcing member integrally formed around an outer periphery of each end of the first fastener and the second fastener, a region between the first fastener and the second fastener is protected by an intermediate reinforcing member integrally formed around outer peripheries of ends of the first fastener and the second fastener, opposite to the reinforcing member, using an intermediate jig.

According to a further aspect of the present invention, there is also provided a method of manufacturing a wire rope sling, which includes a first step of forming a ring using each rope end of a wire rope; a second step of compressing and fixing the rope end on the rope body by a fastener, the rope end being overlapped with a rope body in the first step; a third step of installing and assembling a jig to an end of the fastener at an outer side of the rope end exposed from the fastener; and a fourth step of injecting a molten raw material for forming a reinforcing member into the jig and then separating and dismantling the jig after the raw material is hardened.

According to a still further aspect of the present invention, there is also provided a method of manufacturing a wire rope sling, which includes a first step of configuring a wire rope in a ring shape such that a first rope end and a second rope end of the wire rope are overlapped with each other; a second step of compressing and fixing the first rope end and the second rope end on each other by a first fastener and a second fastener made of metallic material, the first rope end and the second rope end being overlapped with each other in the first step; a third step of installing and assembling jigs on outer sides of ends of the first fastener and the second fastener

around the first rope end and the second rope end exposed from the first fastener and the second fastener and an intermediate jig between the first fastener and the second fastener; and a fourth step of injecting a molten raw material for forming reinforcing members into the jigs and for forming an intermediate reinforcing member into the intermediate jig and then separating and dismantling the jigs and the intermediate jig after the raw material is hardened.

As described above, in the present invention, when a reinforcing member is molded on a metallic fastener, the reinforcing member may be integrally molded on the metallic fastener directly at a work site without any carrying work for lifting up and down a wire rope one by one with a crane, so that it is possible to ensure rapid and convenient work and improve productivity due to the improved workability. In addition, since a manufacturing cost is low, economic feasibility is ensured due to the reduction of manufacturing cost, which provides advantageous effects in cost competitiveness.

Also, since the reinforcing member is integrally formed around the outer periphery of the fastener, the reinforcing member may keep its coupled or fixed state continuous without crack or separation of the reinforcing member due to a difference in material although the reinforcing member is made of a synthetic resin. Accordingly, there is an advantage in that the present invention ensures safety of loading and unloading works in visual aspects and does not make an empty space, at which a surrounding object has been caught in the conventional art, so that the present invention ensures reliability of products.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1a and 2b show a wire rope sling according to a first embodiment of the present invention, wherein Fig. 1a is a sectional view of the entire wire rope sling and Fig. 1b is an enlarged view of a major portion of the wire rope sling;

Fig. 2 is an exploded perspective view showing a jig used for manufacturing the wire rope sling according to the present invention;

Fig. 3 is a sectional view showing an installation state of the jig;

Fig. 4 is a partially enlarged sectional view showing a state where a raw

material is injected into the jig;

Fig. 5 is a partially enlarged sectional view showing a second embodiment of the present invention;

Fig. 6 is a partially enlarged sectional view showing a third embodiment of the present invention;

Fig. 7 is a partially enlarged sectional view showing a fourth embodiment of the present invention;

Fig. 8 is a partially enlarged sectional view showing a fifth embodiment of the present invention;

Fig. 9 is a partially enlarged sectional view showing a sixth embodiment according to the present invention;

Fig. 10 is a sectional view showing an installation state of a jig and an intermediate jig;

Fig. 11 is an exploded perspective view showing an intermediate jig used for manufacturing the wire rope sling according to the present invention;

Fig. 12 is a sectional view showing an example of a conventional wire rope sling; and

Fig. 13 is a sectional view showing another example of a conventional wire rope sling.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, preferred embodiments of a wire rope sling and method of manufacturing the same according to the present invention will be described in detail with reference to the accompanying drawings.

Figs. 1a and 1b show a first embodiment of the present invention, wherein Fig. 1a is a sectional view of the entire wire rope sling according to the present invention and Fig. 1b is an enlarged sectional view of a major portion thereof.

As shown in the figures, a wire rope sling of the present invention has rings 100c respectively formed using both rope ends 102 of a wire rope 100, and the rope end 102 overlapped with a rope body 101 is compressed and fixed on the rope body 101 by

means of a common fastener 1 made of metal. An exposed portion of the rope end 102, which is exposed from the fastener 1, is protected by a reinforcing member 2 integrally formed around an outer periphery of an end of the fastener 1. At this time, the reinforcing member 2 has a tapered portion 2a at its front side and a slope end 2b at its rear end so as to avoid interference with a surrounding object.

The reinforcing member 2 is formed using a jig 3 as shown in Fig. 2.

The jig 3 is composed of an upper mold 3a and a lower mold 3b, which are symmetric to be vertically detachably coupled to each other. The upper and lower molds 3a and 3b have an annular rod shape as a whole when being coupled, and a conically tapered molding portion 36 having a rope hole 30 is formed at one end of the upper and lower molds. Also, a fastener hole 30a is formed at the other end thereof opposite to the tapered molding portion 36, and an inclined end molding step 37 is formed inside of the fastener hole 30a. Also, an injection space 35 formed in the upper and lower molds.

In addition, in order to couple or separate the upper and lower molds 3a and 3b to or from each other, a plurality of upper and lower fixing portions 31 and 32 having coupling holes 33 are integrally formed at front and rear sides of the outer surfaces of the upper and lower molds 3a and 3b, respectively, and bolts 38 and nuts 39 are tightened through the coupling holes 33 of the upper and lower fixing portions 31 and 32 such that the upper and lower molds 3a and 3b can be coupled to each other or separated from each other. At this time, when being coupled, the upper and lower molds 3a and 3b are closely fixed to the fastener 1 inserted into the fastener hole 30a and the wire rope 100 passing through the rope hole 30, thereby preventing a liquid mixed raw material from leaking out of the upper and lower molds 3a and 3b when the molten raw material is injected through an injection port 34 of the upper mold 3a. In addition, the upper mold 3a is formed with an injection port 34 so that a molten raw material may be injected into the injection space 35 in the jig, and a band heater 50 may be further mounted to an outer side of the upper and lower molds 3a and 3b. The band heater 50 may be used or not depending on the raw material used.

The band heater 50 commonly includes a heating wire insulated by mica and an outer portion made of heat-resisting metal such as a galvanized steel sheet or stainless steel sheet. The band heater is very sensitive to temperature control due to a

small thermal capacity and is advantageously heated within a very short time, so that the band heater is closely attached to an outer side of an injection molding machine or an extrusion molding machine to increase a temperature of a cylinder up to 350°C. Band heaters are classified into cylindrical heaters and plate heaters in view of shape, and its power source may be configured in various ways such as lead type and bolt type, but a standard-type power source is enclosed by a band. Here, the band heater 50 is connected to a temperature controller 51, which displays temperature as shown in Fig. 4, via power cables 52, and the temperature controller 51 further includes a temperature sensor 53.

The wire rope sling of the present invention so configured is manufactured by a first step of forming a ring 100c using each rope end 102 of the wire rope 100; a second step of compressing and fixing the rope end 102, which is overlapped with a rope body 101 in the first step, on the rope body 101 by means of a fastener 1; a third step of installing and assembling a jig 3, to which the band heater 50 is mounted, to an end of the fastener 1 at an outer side of the rope end 102 exposed from the fastener 1; and a fourth step of injecting a molten raw material for forming a reinforcing member into the jig 3 and then separating and dismantling the jig 3 after the raw material is hardened.

Now, a method of manufacturing a wire rope sling according to a first embodiment of the present invention will be described below in detail with reference to the accompanying drawings.

In the first step, the rope end 102 of the wire rope 100 is bent toward the rope body 101 to form the ring 100c as in a common case, whereby the rope end 102 is overlapped with the rope body 101.

In the second step, the hollow sleeve-shaped fastener 1 made of a metallic material such as aluminum is fit around the outside of the rope body 101 and the rope end 102 that are overlapped with each other, and then the fastener 1 is compressed by means of a fastener compressing device (not shown) to compress and fix the rope end 102 on the rope body 101.

In the third step, the reinforcing member 2 is molded on an outside of an exposed portion of the rope end 102 which is compressed and fixed on the rope body 101 by the fastener 1 and exposed out of the fastener 1. First, as shown in Fig. 3, the

jig 3 is installed to an end of the fastener 1, i.e., an end where the rope end 102 is exposed. At this time, for installing the jig, a semicircular groove having an upper portion opened to define the fastener hole 30a of the jig 3 is fit around a lower outer side of the fastener 1, and at the same time, the rope body 101 of the wire rope 100 is inserted into and caused to pass through a semicircular groove having an upper portion opened to define the rope hole 30 located opposite to the fastener hole 30a.

Thereafter, similarly to the lower mold 3b, a semicircular groove having a lower portion opened to define the fastener hole 30a of the jig 3 is fit around an upper outer side of the fastener 1, and at the same time, the rope body 101 of the wire rope 100 is inserted into and caused to pass through a semicircular groove having a lower portion opened to define the rope hole 30 located opposite to the fastener hole 30a, whereby the upper mold 3a is fit to the lower mold 3b. Then, the bolts 38 and the nuts 39 are fastened through the coupling holes 33 of the upper and lower fixing portions 31 and 32 of the upper and lower molds 3a and 3b facing each other, thereby closely fixing the upper and lower molds 3a and 3b to the end of the fastener 1 and the rope body 101.

In the fourth step, a liquid raw material for forming the reinforcing member is injected into the jig 3 installed and assembled at the end of the fastener 1 and the rope body 101 and becomes a reinforcing member 2 in the jig 3. If a liquid raw material 5 contained in a basket 5b is injected into the jig 3 through a funnel 5a inserted into the injection port 34 of the upper mold 3a as shown in Fig. 4, the injected liquid raw material is filled in the injection space 35 and the inside of the tapered molding portion 36 and also permeates into the inside of the rope body 101 and rope end 102 of the wire rope 100, which are overlapped with each other. Further, the liquid raw material is filled in the inner space between the jig 3 and the fastener 1, which is formed by the inclined end molding step 37, i.e., surrounds an outer periphery of the end of the fastener 1.

In the present invention, the liquid raw material can be a molten metal or a mixed raw material for urethane rubber. At this time, in a case where the raw material injected into the jig 3 is the molten metal, the raw material is obtained by putting zinc or aluminum lumps into a container and then heating and melting the lumps by a gas burner. The raw material is hardened after about 5 minute air-cooling.

However, in a case where the raw material is the mixed raw material for

urethane rubber, the raw material is hardened by heating. Thus, the jig 3 is preheated up to 100 °C to 110°C by the band heater 50 before the raw material is injected. Since the injected liquid urethane rubber reacts by heat and is hardened, the injected urethane rubber is heated to 80°C to 100°C for about 15 minutes after injection, and then the raw material injected into the jig is left alone for 4 hours in a state of 80°C to 100°C and then completely hardened. The band heater 50 is installed to surround an outer side of a front, rear or a middle portion of the jig 3 and is connected to the temperature controller 51 via the power cables 52. The temperature sensor 53 of the temperature controller 51 is installed to the outer side of the jig 3.

In general, the urethane rubber is also referred to as a urethane elastomer. The urethane rubber has several thousand molecular weight, and polyether or polyester having hydroxyl groups at both ends is used as a starting material. The former may be obtained from ethylene oxide or propylene oxide, and the latter may be obtained by reaction between dibasic acid such as adipic acid and ethylene glycol or propylene glycol. Thereafter, if polyether or polyester reacts with isocyanate such as toluenediisocyanate, prepolymer having isocyanate groups or hydroxyl groups at both ends is produced. When the prepolymer is put into the jig 3, glycol or diamine is added as a crosslinking agent if isocyanate groups are excessive, and diisocyanate, oxide or sulfur is added as a crosslinking agent if hydroxyl groups are excessive, thereby forming a network structure and thus making a synthetic rubber product. The molding process is generally performed under a pressed and heated state. The synthetic rubber product is weather-resistant and acid-resistant due to the absence of double bond and is excellent in mechanical strength, abrasion resistance and impact resistance due to the presence of urethane bond. Here, a liquid raw material for molding a reinforcing member of a urethane rubber, i.e., a mixture of polyether or polyester, diisocyanate, a crosslinking agent and catalyst, is referred to as a liquid mixed raw material.

In addition, if the liquid raw material is injected into the jig 3 and then hardened as described above, the jig 3 is separated and dismantled. First, the bolts 38 and nuts 39 fastened to the upper and lower fixing portions 31 and 32 of the upper and lower molds 3a and 3b are released to release the coupling between the upper mold 3a and the lower mold 3b, and then the upper mold 3a is separated from the lower mold 3b.

Thereafter, the lower mold 3b is separated from the reinforcing member 2 which is formed by hardening the injected raw material, thereby completely making the wire rope sling according to the first embodiment of the present invention.

Figs. 5 to 8 show other embodiments of the present invention.

Fig. 5 is a partially enlarged sectional view showing a wire rope sling according to a second embodiment of the present invention. Here, this embodiment is characterized in that an injection groove 12 is formed along an outer periphery of an end of the fastener 1 where the reinforcing member 2 is integrally formed. The injection groove 12 is formed to have a rectangular cross-section in a direction perpendicular to the fastener 1. The injection groove 12 may be formed in an annular band shape, or there are provided a plurality of injection grooves spaced apart from each other at certain intervals. In a case where injection grooves 12 of an annular band shape are formed in succession along the outer periphery of the fastener 1, it is preferred that the depth of the injection grooves 12 is not too great in consideration of the strength of the adjacent end of the fastener 1.

If the injection groove 12 is formed in the fastener 1 as described above, the liquid raw material injected into the jig 3 is filled in the injection groove 12 and then hardened. Thus, when an external force is applied to the reinforcing member 2 in an axial direction of the fastener 1, the reinforcing member 2 is caught to the injection groove 12 and thus resists the external force, so that the reinforcing member 2 can be fixed to the fastener 1 more firmly.

Fig. 6 is a partially enlarged sectional view showing a wire rope sling according to a third embodiment of the present invention. This embodiment is characterized in that an injection groove 13 is formed along an outer periphery of an end of the fastener 1 where the reinforcing member 2 is integrally formed, similarly to the second embodiment. However, this embodiment differs from the second embodiment in that the injection groove 13 has a dove tail-shaped cross-section that is open in a direction perpendicular to the axial direction of the fastener 1 through which the wire rope 100 passes.

If the injection groove 13 is formed to have a dove tail-shaped cross-section as described above, the wire rope 100 may have resistance in a vertical direction perpendicular to the fastener 1 as well as an axial direction of the fastener 1, i.e., a

horizontal direction in which the wire rope 100 passes. Thus, there is an advantage in that the reinforcing member 2 may be more firmly fixed to the fastener 1 as compared with the injection groove 13 having a rectangular cross-section.

Fig. 7 is a partially enlarged sectional view showing a wire rope sling according to a fourth embodiment of the present invention, and Fig. 8 is a partially enlarged sectional view showing a wire rope sling according to a fifth embodiment of the present invention. Here, these embodiments are characterized in that injection holes 14 are formed in the injection grooves 12 and 13 of the second and third embodiments to pass through the fastener 1 in a direction perpendicular to the axial direction of the respective fasteners 1.

If the injection holes 14 are formed together with the injection groove 12 of a rectangular cross-section or the injection groove 13 of a dove tail-shaped cross-section, the injected raw material permeates into not only the injection groove 12 or 13 but also the rope body 101 and the rope end 102 in the fastener 1 through the injection hole 14. Thus, the coupling force between the rope body 101 and the rope end 102 is added to the horizontal and vertical resisting forces according to the second and third embodiments, so that the rope end 102 can be fixed to the rope body 101 more firmly and more securely.

Fig. 9 is a partially enlarged sectional view showing a sixth embodiment according to the present invention, Fig. 10 is a sectional view showing an installation state of a jig and an intermediate jig, and Fig. 11 is an exploded perspective view showing an intermediate jig used for manufacturing the wire rope sling according to the present invention.

The wire rope sling according to the sixth embodiment according to the present invention has a ring shape as a whole, and both ends of the wire rope 100 are overlapped with each other. In other words, as shown in Fig. 9, a first rope end 102a and a second rope end 102b overlapped with each other are compressed and fixed on each other by means of a pair of first metallic fastener 1a and second metallic fastener 1b. Also, the outside of the first rope end 102a and the second rope end 102b exposed from the first fastener 1a and the second fastener 1b is protected by molding the reinforcing members 2 using the jigs 3 in the same manner as the first embodiment of the present invention, and an intermediate reinforcing member 6 is molded between the

first fastener 1a and the second fastener 1b by means of an intermediate jig 4 separately fabricated. The intermediate reinforcing member 6 has slope ends 6a at both ends thereof.

In the present invention, the intermediate jig 4 is composed of an upper mold 4a and a lower mold 4b, which are symmetric to be separated from or coupled to each other in a vertical direction as shown in Fig. 11. The upper mold 4a and the lower mold 4b respectively has an annular rod shape as a whole when being coupled, and fastener holes 40 are formed at both sides of the upper mold 4a and the lower mold 4b. In addition, an inclined end molding steps 46 are formed within the fastener hole 40, and an injection space 45 is defined in the upper mold 4a and the lower mold 4b.

In addition, in order to couple or separate the upper mold 4a and the lower mold 4b to or from each other, a plurality of upper and lower fixing portions 41 and 42 having coupling holes 43 are integrally formed at front and rear sides of the outer surface of the upper mold 4a and the lower mold 4b, respectively, and bolts 48 and nuts 49 are tightened through the coupling holes 43 of the upper and lower fixing portions 41 and 42 such that the upper mold 4a and the lower mold 4b can be coupled to each other or separated from each other. At this time, when being coupled, the upper mold 4a and the lower mold 4b are closely fixed to the fasteners 1 inserted into the fastener hole 40, so that when a raw material in a molten state is injected through an injection port 44 of the upper mold 4a, it is possible to prevent the liquid raw material from leaking out of the upper mold 4a and the lower mold 4b. In addition, the upper mold 4a is formed with the injection port 44 so that a molten raw material may be injected into the injection space 45 in the jig 3, and the band heater 50 as described above may be further mounted to an outer side of the upper mold 4a and the lower mold 4b.

The wire rope sling of the sixth embodiment of the present invention so configured is manufactured by a first step of forming the wire rope in a ring shape such that the first rope end 102a and the second rope end 102b of the wire rope 100 are overlapped with each other; a second step of compressing and fixing the first rope end 102a and the second rope end 102, which are overlapped with each other in the first step, on each other by means of the first fastener 1a and the second fastener 1b made of metallic material; a third step of installing and assembling the jigs 3 on outer sides of the ends of the first fastener 1a and the second fastener 1b around the first rope end

102a and the second rope end 102b exposed from the first fastener 1a and the second fastener 1b and the intermediate jig 4 between the first fastener 1a and the second fastener 1b; and a fourth step of injecting a molten raw material into the jigs 3 and the intermediate jig 4 and then separating and dismantling the jigs 3 and the intermediate jig 4 after the raw material is hardened.

A method of manufacturing a wire rope sling according to the sixth embodiment will be described below in detail with reference to the accompanying drawings.

In the first step, both ends of the wire rope 100, i.e., the first rope end 102a and the second rope end 102b are overlapped with each other, so that the wire rope 100 is formed in the shape of a ring, as in a common case.

In the second step, the first rope end 102a and the second rope end 102b overlapped with each other are compressed and fixed on each other by means of a pair of first fastener 1a and second fastener 1b, and the first fastener 1a and the second fastener 1b are spaced apart from each other and compress and fix the first rope end 102a and the second rope end 102.

In the third step, the jigs 3 are respectively installed outside of the ends of the first fastener 1a and the second fastener 1b where the first rope end 102a and the second rope end 102b are exposed, and the intermediate jig 4 is installed between the first fastener 1a and the second fastener 1b, as shown in Fig. 10. Since the installation process of the jig 3 is identical to that of the first embodiment, the specific descriptions thereon will be omitted so as to avoid repeated descriptions, and only an installation process of the intermediate jig 4 will be described in detail.

First, semicircular grooves of the fastener holes 40 formed at both sides of the lower mold 4b and having an upper portion opened is fit on the lower outside of the first fastener 1a and the second fastener 1b, and semicircular grooves of the fastener holes 40 formed at both sides of the upper mold 4a and having a lower portion opened is fit on an upper outside of the first fastener 1a and the second fastener 1b. Thereafter, the bolts 48 and nuts 49 are tightened through the coupling holes 43 formed in the upper and lower fixing portions 41 and 42 on the outer sides of the upper mold 4a and the lower mold 4b which face each other, thereby closely fixing the upper mold 4a and the lower mold 4b to the respective ends of the first fastener 1a and the second

fastener 1b.

In the fourth step, a liquid raw material is injected into the jigs 3 and the intermediate jig 4 installed and assembled to the first fastener 1a and second fastener 1b. Thereafter, if the raw material is hardened, the jigs 3 and the intermediate jig 4 are dismantled and disassembled to be separated from the first fastener 1a and the second fastener 1b. Firstly, a liquid raw material is injected through the injection ports 34 and 44 of the jigs 3 and the intermediate jig 4 in the same manner as the first embodiment. In other words, in case of the intermediate jig 4, if the raw material is injected through the injection port 44, the injected liquid raw material is filled in the injection space 45 and permeates into the first rope end 102a and the second rope end 102b. In addition, the raw material is filled in a space between the intermediate jig 4 and the first fastener 1a and second fastener 1b, which is formed by the inclined end molding steps 46, i.e., surrounds outer peripheries of the ends of the first fastener 1a and the second fastener 1b.

At this time, in a case where the raw material injected into the intermediate jig 4 is a molten metal as in the first embodiment, the raw material is hardened by 5 minute air-cooling after the injection. However, in case of a liquid urethane rubber, the intermediate jig 4 preheated up to 100°C to 110°C by the band heater 50 is heated to 80 to 100°C for about 15 minutes after the raw material is injected, whereby the injected raw material reacts by heat and is hardened. For the enhancement of hardness, the raw material injected into the jig is left alone for 4 hours at 80 to 100°C and then completely hardened. If the raw material is injected into the jigs 3 and the intermediate jig 4 and then hardened, the jigs 3 and the intermediate jig 4 are dismantled and dissembled as in the first embodiment of the present invention and then separated from the first fastener 1a and the second fastener 1b, thereby completely molding the reinforcing members and the intermediate reinforcing member.

Meanwhile, in the wire rope sling according to the sixth embodiment of the present invention and its manufacturing method, injection holes 14 may be formed along an outer periphery of an end of the first fastener 1a or the second fastener 1b to which the reinforcing members 2 and the intermediate reinforcing member 6 are integrally molded, or an injection groove 12 having a rectangular cross-section or an injection groove 13 having a dove tail-shaped cross-section may be formed therein, like

the second to fifth embodiments, but the specific descriptions thereon will be omitted so as to avoid repeated descriptions.

According to the present invention so configured, when a reinforcing member made of a synthetic resin is molded on a metallic fastener, the reinforcing member may be integrally molded on the metallic fastener directly at a work site without any carrying work for lifting up and down a wire rope one by one with a crane, so that it is possible to ensure rapid and convenient work and improve productivity due to the improved workability. Also, since a manufacturing cost is low, economic feasibility is ensured due to the reduction of manufacturing cost. In addition, since the reinforcing member is integrally formed around the outer periphery of the fastener, the reinforcing member may keep its coupled or fixed state continuous without crack or separation of the reinforcing member due to a difference in material although the reinforcing member is made of a synthetic resin.

The wire rope sling and its manufacturing method have been described in detail, but such descriptions are just preferred embodiments of the present invention, and the scope of the present invention is not limited thereto but is defined by the appended claims. It will be apparent that those skilled in the art can make various modifications and changes thereto based on the descriptions of the present invention. It will be apparent that such modifications and changes do not depart from the scope of protection of the present invention.

WHAT IS CLAIMED IS:

1. A wire rope sling, wherein rings (100c) are respectively formed using both rope ends (102) of a wire rope (100), the rope end (102) overlapped to a rope body (101) is compressed and fixed on the rope body (101) by a fastener (1) made of metallic material, and an exposed portion of the rope end (102) exposed from the fastener (1) is protected by a reinforcing member (2) integrally formed around an outer periphery of an end of the fastener (1), where the reinforcing member (2) is made by a jig (3).
2. The wire rope sling as claimed in claim 1, wherein the reinforcing member (2) is made of a metallic material which is formed by hardening a molten metal injected into the jig (3) and has a tapered portion (2a) and a slope end (2b) at front and rear sides thereof, respectively.
3. The wire rope sling as claimed in claim 1, wherein the reinforcing member (2) is formed by hardening a urethane rubber injected into the jig (3) by heating a band heater (50) mounted to the jig (3) and has a tapered portion (2a) and a slope end (2b) at front and rear sides thereof, respectively.
4. The wire rope sling as claimed in claim 1, wherein the fastener (1) further includes an injection groove (12) having a rectangular cross-section or an injection groove (13) having a dove tail-shaped cross-section, where the rectangular cross-sectional injection groove (12) and the dove tail-shaped cross-sectional injection groove (13) are formed along an outer periphery of an end of the fastener (1) respectively.
5. The wire rope sling as claimed in claim 4, wherein the fastener (1) further includes a plurality of vertical injection holes (14) formed along an outer periphery of an end of the rectangular cross-sectional injection groove (12) and an outer periphery of an end of the dove tail-shaped cross-sectional injection groove (13).

6. A wire rope sling, wherein a wire rope (100) is formed in a ring shape so that a first rope end (102a) and a second rope end (102b) of the wire rope (100) overlapped with each other are compressed and fixed on each other by a first fastener (1a) and a second fastener (1b) made of metallic material, each exposed portion of the first rope end (102a) and the second rope end (102b) exposed from the first fastener (1a) and the second fastener (1b) is protected by a reinforcing member (2) integrally formed around an outer periphery of each end of the first fastener (1a) and the second fastener (1b), where the reinforcing member (2) is made by a jig(3), and a region between the first fastener (1a) and the second fastener (1b) is protected by an intermediate reinforcing member (6) integrally formed around outer peripheries of ends of the first fastener (1a) and the second fastener (1b), where the intermediate reinforcing member (6) is made by an intermediate jig (4).

7. The wire rope sling as claimed in claim 6, wherein the reinforcing member (2) is made of a metallic material which is formed by hardening a molten metal injected into the jig (3) and has a tapered portion (2a) and a slope end (2b) at front and rear sides thereof, respectively, and the intermediate reinforcing member (6) is formed by hardening a molten metal injected into the intermediate jig (4) and has slope ends (6a) at both ends thereof.

8. The wire rope sling as claimed in claim 6, wherein the reinforcing member (2) is made of a urethane rubber which is injected into the jig (3) and formed by heating a band heater (50) and has a tapered portion (2a) and a slope end (2b) at front and rear sides thereof, respectively, and the intermediate reinforcing member (6) is formed by hardening the urethane rubber injected into the intermediate jig (4) and has slope ends (6a) at both ends thereof.

9. The wire rope sling as claimed in claim 6, wherein the first fastener (1a) and the second fastener (1b) further include an injection groove (12) having a rectangular cross-section or an injection groove (13) having a dove tail-shaped cross-section, where the rectangular cross-sectional injection groove (12) and the dove tail-shaped cross-sectional injection groove (13) are formed along an outer periphery of an end of the

first fastener (1a) and the second fastener (1b) respectively.

10. The wire rope sling as claimed in claim 9, wherein the first fastener (1a) and the second fastener (1b) further include a plurality of vertical injection holes (14) formed along an outer periphery of an end of the rectangular cross-sectional injection groove (12) and an outer periphery of an end of the dove tail-shaped cross-sectional injection groove (13).

11. A method of manufacturing a wire rope sling, comprising:
 a first step of forming a ring (100c) using each rope end (102) of a wire rope (100);
 a second step of compressing and fixing the rope end (102) on the rope body (101) by a fastener (1) made of metallic material, the rope end (102) being overlapped with a rope body (101) in the first step;
 a third step of installing and assembling a jig (3) to an end of the fastener (1) at an outer side of the rope end (102) exposed from the fastener (1); and
 a fourth step of injecting a molten raw material for forming a reinforcing member (2) into the jig (3) and then separating and dismantling the jig (3) after the raw material is hardened.

12. The method of manufacturing a wire rope sling as claimed in claim 11, wherein the molten raw material injected into the jig(3) is a molten metal.

13. The method of manufacturing a wire rope sling as claimed in claim 11, wherein the molten raw material injected into the jig(3) is a mixed raw material for urethane rubber and the jig(3) further includes a band heater (50).

14. The method of manufacturing a wire rope sling as claimed in claim 11, wherein the second step further includes the step of forming a rectangular cross-sectional injection groove (12) or a dove tail-shaped cross-sectional injection groove (13), where the rectangular cross-sectional injection groove (12) and the dove tail-shaped cross-sectional injection groove (13) are formed along an outer periphery of an

end of the fastener (1) respectively.

15. The method of manufacturing a wire rope sling as claimed in claim 11, wherein the second step further includes the step of forming a plurality of vertical injection holes (14) formed along an outer periphery of an end of the rectangular cross-sectional injection groove (12) and an end of the dove tail-shaped cross-sectional injection groove (13).

16. The method of manufacturing a wire rope sling as claimed in claim 11, wherein the jig (3) includes:

an upper mold (3a) having an injection port (34) and a plurality of upper fixing portions (31) at an outer side thereof,

a lower mold (3b) having lower fixing portions (32) corresponding to the upper fixing portions (31), so that the upper mold (3a) and the lower mold (3b) are coupled with each other by tightening bolts (38) and nuts (39) through coupling holes (33) of the upper mold (3a) and the lower mold (3b), and

a fastener hole (30a) having an inclined end molding step (37) in one side and a rope hole (30) being formed in the other side of the upper mold (3a) and the lower mold (3b) coupled with each other.

17. A method of manufacturing a wire rope sling, comprising:

a first step of configuring a wire rope (100) in a ring shape such that a first rope end (102a) and a second rope end (102b) of the wire rope (100) are overlapped with each other;

a second step of compressing and fixing the first rope end (102a) and the second rope end (102b) on each other by a first fastener (1a) and a second fastener (1b) made of metallic material, the first rope end (102a) and the second rope end (102b) being overlapped with each other in the first step;

a third step of installing and assembling jigs (3) on outer sides of ends of the first fastener (1a) and the second fastener (1b) around the first rope end (102a) and the second rope end (102b) exposed from the first fastener (1a) and the second fastener (1b) and an intermediate jig (4) between the first fastener (1a) and the second fastener

(1b); and

a fourth step of injecting a molten raw material into the jigs (3) for forming reinforcing members (2) and into the intermediate jig (4) for forming an intermediate reinforcing member (6) and then separating and dismantling the jigs (3) and the intermediate jig (4) after the molten raw material is hardened.

18. The method of manufacturing a wire rope sling as claimed in claim 17, wherein the molten raw material injected into the jig (3) and the intermediate jig (4) is a molten metal.

19. The method of manufacturing a wire rope sling as claimed in claim 17, wherein the raw material injected into the jig (3) and the intermediate jig (4) is a mixed raw material for urethane rubber and the jig(3) and the intermediate jig (4) further include a band heater (50) respectively.

20. The method of manufacturing a wire rope sling as claimed in claim 17, wherein the second step further includes the step of forming a rectangular cross-sectional injection groove (12) or a dove tail-shaped cross-sectional injection groove (13), where the rectangular cross-sectional injection groove (12) and the dove tail-shaped cross-sectional injection groove (13) are formed along an outer periphery of an end of the first fastener (1a) and a second fastener (1b) respectively.

21. The method of manufacturing a wire rope sling as claimed in claim 20, wherein the second step further includes the step of forming a plurality of vertical injection holes (14) formed along an outer periphery of an end of the rectangular cross-sectional injection groove (12) and an end of the dove tail-shaped cross-sectional injection groove (13).

22. The method of manufacturing a wire rope sling as claimed in claim 17, wherein the intermediate jig (4) includes:
an upper mold (4a) having an injection port (44) and a plurality of upper fixing portions (41) at an outer side thereof,

a lower mold (4b) having lower fixing portions (42) corresponding to the upper fixing portions (41), so that the upper mold (4a) and the lower mold (4b) are coupled with each other by tightening bolts (48) and nuts (49) through coupling holes (43) of the upper fixing portion (41) and the lower fixing portion (42), and fastener holes (40) each having an inclined end molding step (46) formed in both sides of the upper mold (4a) and the lower mold (4b) coupled with each other.