United States Patent [19]

Smith

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[54] **SELF-COILING WIRE CABLE AND METHOD OF FORMING SAME**

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[73] Assignee: **Helistrand, Inc.**, Santa Barbara, Calif.

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[52] **U.S. Cl.** **57/139**, 57/166, 70/18, 72/127, 140/149

[51] **Int. Cl.** **D07b 1/16**, B21f 3/02, E05b 7/00

[58] **Field of Search** ..... 57/9, 13, 34 R, 55, 57/139, 144, 145, 148, 149, 153, 156, 160, 161, 162, 164, 166; 70/18, 49, 53; 72/127; 140/102, 124, 149

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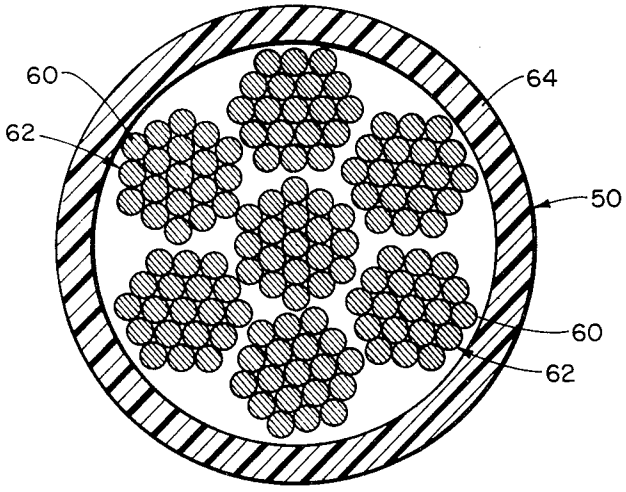
Primary Examiner—Donald E. Watkins
Attorney—Robert E. Geauque et al.

[57] **ABSTRACT**

A locking cable which is constructed of a plurality of separate strands with each strand containing a plurality of separate wires, each wire being between 0.005 and 0.012 of an inch in diameter. One side of the cable along its entire longitudinal length is stretched so that the material along that side is caused to exceed its yield point and be permanently deformed. As a result, the cable assumes a natural helical coiled configuration. A plastic cover may be applied to the cable in a close fitting relationship to help prevent the cable from becoming untwisted. The method of making the helical coiled cable comprises preforming and twisting of a plurality of separate wires together in a clockwise direction to form a strand, preforming and twisting a plurality of separate strands together in a counterclockwise direction to form the cable, and stretching one side of the cable along its entire length. An apparatus to perform the method of this invention comprises a pair of roller assemblies through which the cable is conducted with the cable being passed about a pin with an angular displacement exceeding 190°. The cable is passed through the apparatus in an extremely taut manner which causes one side of the cable to be permanently deformed.

29 Claims, 8 Drawing Figures



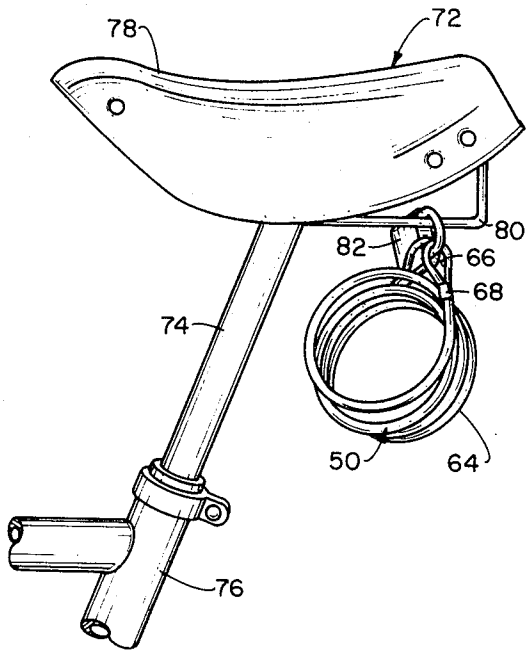


Fig. 1.

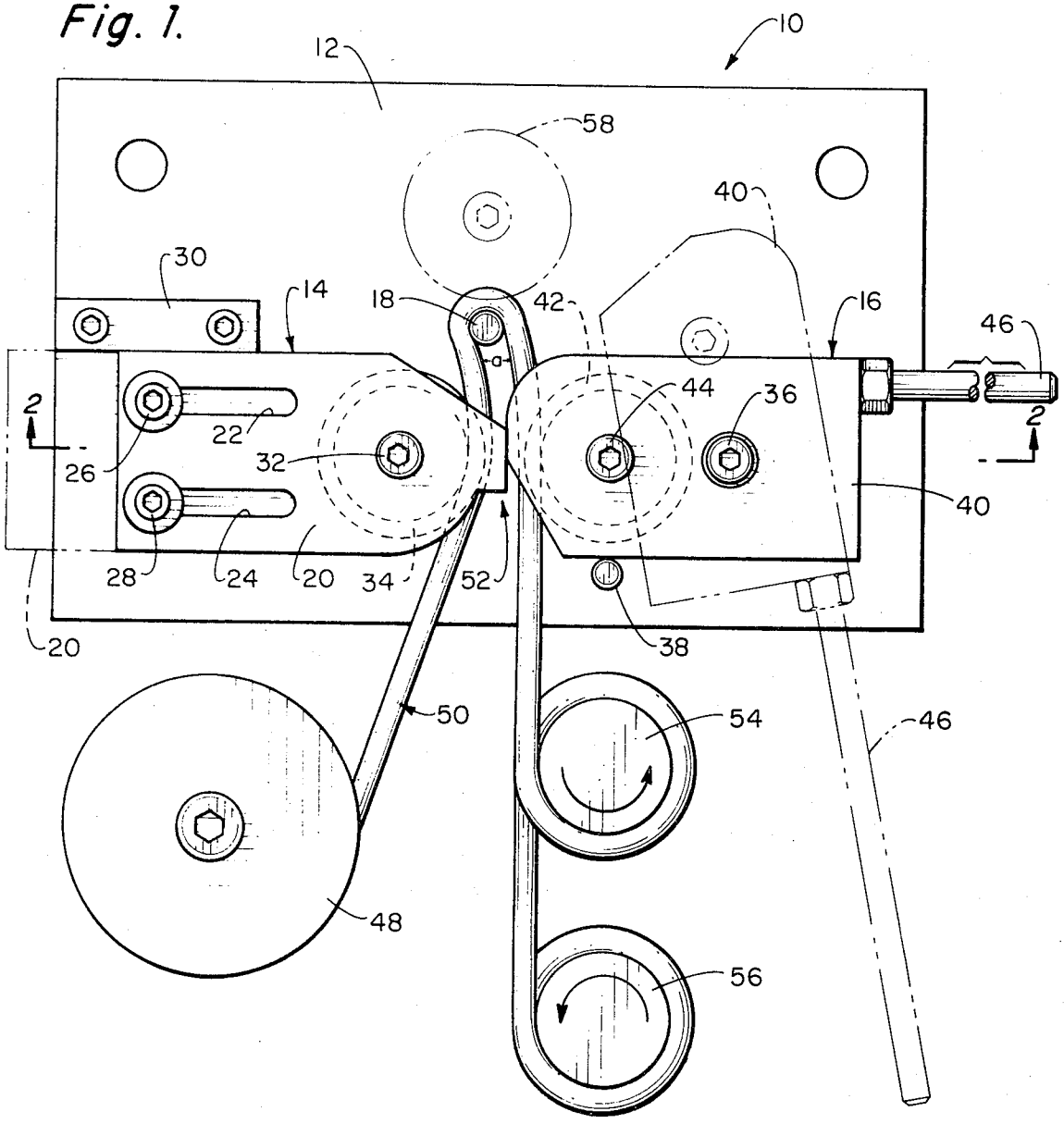

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Fig. 2.

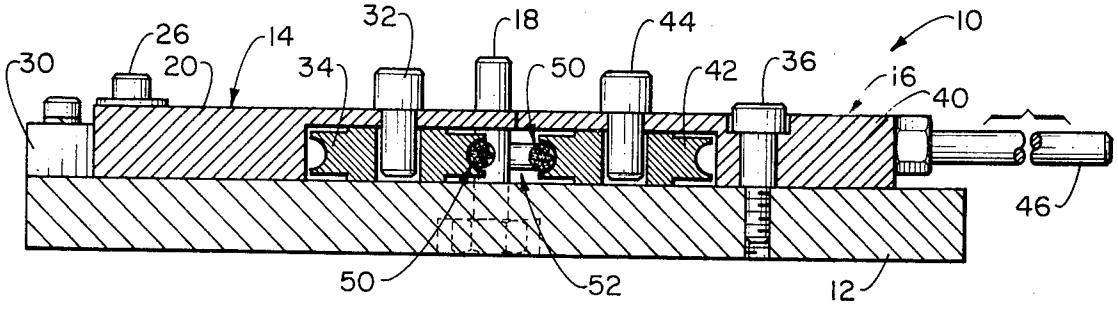
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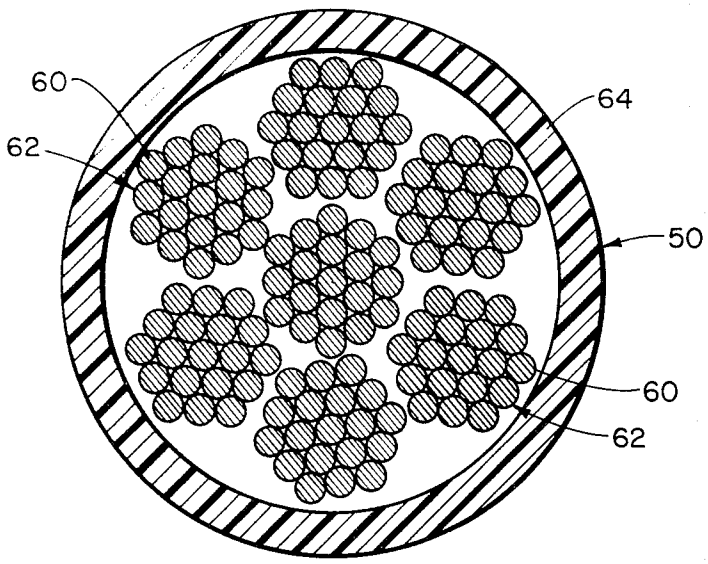
Fig. 3.



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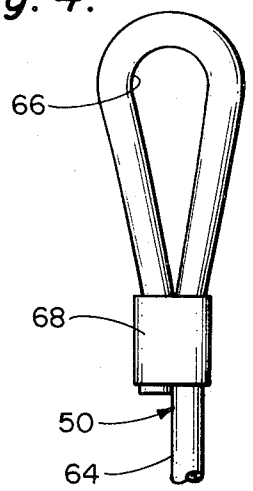

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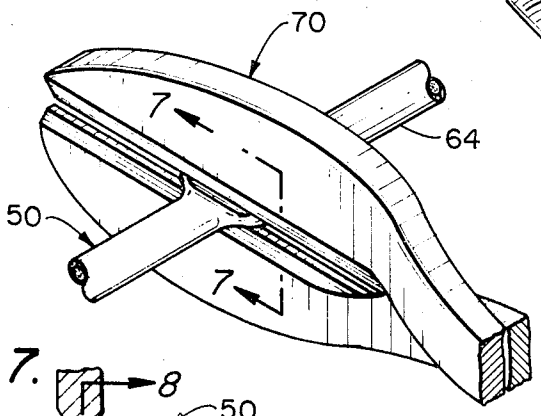


Fig. 6.

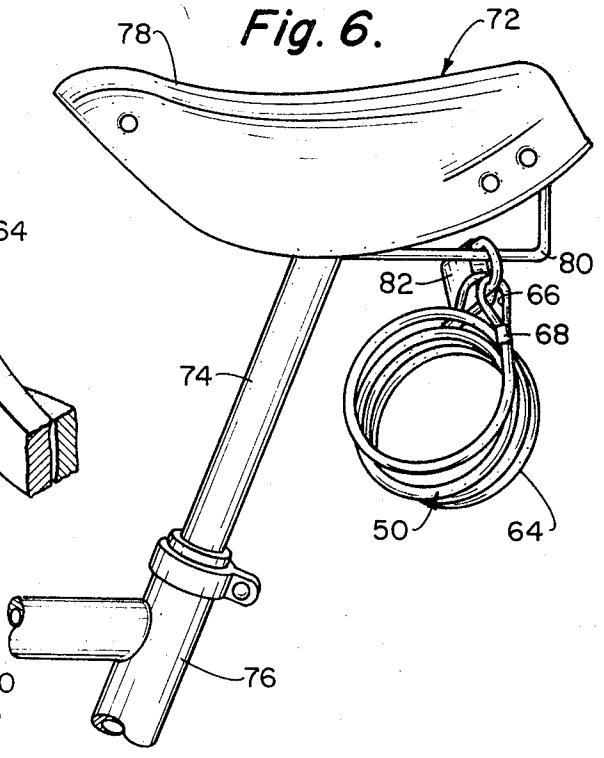


Fig. 7.

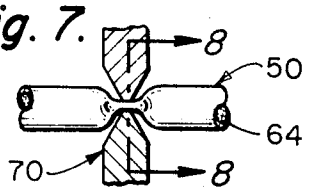
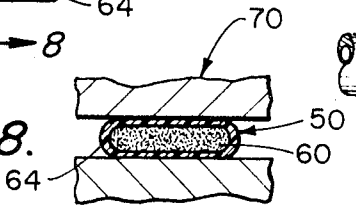


Fig. 8.



SELF-COILING WIRE CABLE AND METHOD OF FORMING SAME

BACKGROUND OF THE INVENTION

The theft of small vehicles such as bicycles and motorcycles is most common. The normal procedure to tend to prevent the theft of such vehicles is to employ the use of a cable or chain which is to be wrapped around both the vehicle and a fixed object, such as a tree or post, with the chain or cable then being locked by a padlock or other similar type of lock. A conventional light-weight chain or cable having a diameter smaller than three-sixteenths inch, or having wires more than 0.020 inch diameter can be readily cut by bolt cutters or other similar types of cutting apparatuses within a matter of seconds. Therefore, the use of such conventional chains and cables are proving to be ineffective toward preventing stealing of such light-weight vehicles.

In an effort to further prevent theivery of small vehicles, it has been common to employ a heavier type of chain or cable. However, with bicycles, where it is desired that the weight of the vehicle be minimized, it is not uncommon for the security chain or cable to weigh 5 to 10 pounds for a 3 to 6 foot length. Therefore, the advantage of having a light-weight vehicle is completely eliminated when such heavy devices are employed.

Another disadvantage of chain is that it is extremely difficult to store when not in use. The normal procedure is for the chain to be wound around a portion of the frame of the bicycle. Frequently, this chain inteferes with the operator's use of the bicycle.

The use of a cable is more desirable since the cable cannot be as easily cut as a chain. However, with a piece of straight cable, when it is wound into a coil, it assumes a coil diameter of thirty to forty times the cable diameter. Also, the cable normally must be tied or otherwise restrained to prevent violent unwinding. This makes the carrying of a straight cable along with the bicycle extremely difficult.

Therefore, the need exists for a strong, light-weight cable which is easy to stow in a small space and which may easily be carried on a small vehicle safely and which has a pleasing appearance when not in use.

SUMMARY OF THE INVENTION

The cable of this invention overcomes the disadvantages cited above by providing a strong, lightweight cable which is preformed to assume a compact helical coil when not in use and which is easily straightened by application of a light load when in use. Upon removal of the load, the cable quickly recoils and is maintained in its coiled shape. The coiled cable is sheated in a circular plastic jacket which protects the cable from damage and reduces marking or scuffing of the article being secured. The coil size of the cable is only ten to fifteen times the size of the cable diameter which substantially reduces the bulk of the coiled cable to approximately one-fourth of that of a straight cable wound into a coil. The cable of this invention may be used in other environments such as a towing cable or an animal tether or a tie-up line as for a boat. When using the apparatus of this invention as a towing cable, the natural tendency of the cable to recoil prevents slack from dragging upon the road and becoming entangled.

This invention also includes the apparatus and method for the manufacturing of the coiled cable. the coiled cable is to be forcibly conducted around a pin within an apparatus which causes a longitudinal edge of the cable to be stretched and be permanently deformed. With only one side of the cable being deformed, a constant torque is then applied to the remainder of the cable tending to coil the cable.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the apparatus of this invention which is employed to produce the coiled cable;

FIG. 2 is a cross-sectional view of the apparatus shown in FIG. 1 taken along line 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view through the coiled cable of this invention;

FIG. 4 is a fragmentary view of one of the looped ends of the coiled cable of this invention;

FIG. 5 is a diagrammatic view of a cutting device attempting to cut the cable of this invention; and

FIG. 6 is a view showing the cable of this invention being stored upon a vehicle such as a bicycle or motorcycle.

DETAILED DESCRIPTION OF THE SHOWN EMBODIMENTS

Referring particularly to FIG. 1 of the drawings, there is shown an apparatus 10 being generally composed of a housing 12, a first roller assembly 14 and a second roller assembly 16. Fixedly secured within the housing 12 is an upstanding pin 18.

The first roller assembly 14 includes a roller housing 20 which includes a pair of spaced apart slots 22 and 24. Bolt 26 cooperates with slot 22 and is mounted within the housing 12. Bolt 28 cooperates with slot 24 and is also mounted within the housing 12. The housing 20 is movable with respect to the bolts 26 and 28 with the limits of movement of the bolts 26 and 28 being determined by the length of the respective slots 22 and 24. A guide 30 is secured to the housing 12 and is adapted to permit movement of the housing 20 in a single longitudinal direction. Rotatably mounted by means of pivot pin 32 within the housing 20 is a roller 34. The function of the roller 34 will be explained further on in the specification.

The second roller assembly 16 is pivotally mounted upon the housing 12 by means of pin 36. A stop pin 38 is mounted upon the housing 12 and is adapted to limit the pivotal movement in one direction of the housing 40 of the second roller assembly 16. A roller 42 is pivotally mounted by pin 44 within the housing 40. A handle 46 is fixedly secured to one side of the housing 40.

A cable 50, which is conducted from a supply reel 48, is to be conducted through the operating space 52 located between the rollers 34 and 42 and about pin 18. The cable is then conducted through the operating space 52 so that one side of the cable is in contact with roller 34 and the other side of the cable is in contact with roller 42. It is to be understood that the cable is placed about the pin 18 and through the operating space 52 when the second roller assembly 16 is pivoted to the position shown in phantom in FIG. 1. This pivoting of the second roller assembly 16 facilitates access to within the operating space 52. The free end of the cable 50 is then conducted about a capstan puller 54 and then placed upon a rewind reel 56. Other means of

pulling the cable through the apparatus may be employed.

In normal operation of the apparatus **10** of this invention the cable **50** will be angularly displaced about pin **18** so that the amount of displacement past 360° (angle *a*) is approximately 10° to 30°. The pin **18** has a small radius preferably in the order of 0.5 to 1.5 cable diameter and the cable is conducted around the pin at uniform tension and speed. It may be readily seen that by this displacement, the outer peripheral surface of the cable **50** which is conducted about the pin **18** is stretched and is forced to assume a longer configuration than the interior portion of the cable **50**. It has been found that when the cable **50** is maintained taut, the pulling of the cable over the pin **18** results in the outer portion of the cable **50** becoming permanently deformed. The material of construction of the cable **50** will normally be twisted strands of metal wire. The periphery of the cable **50** along its entire longitudinal length exceeds the yield point for the metallic material and therefore does not return to its initial state. As a result, one side of the cable **50** exerts a continuous force upon the remainder of the cable tending to curl the cable. This curling effect causes the cable **50** to assume a helical coiled configuration of FIG. **6**. In actual practice a restraining roller **58** may be pivotally mounted upon the housing **12** to hold the cable **50** in particular alignment upon the pin **18**. Also, by adjusting the first roller assembly **14** by means of loosening and fastening of bolts **26** and **28**, the angular displacement of the cable **50** about the pin **18** can be varied. Normally, the greater the angular displacement, the smaller in size of coil that is produced.

Referring particularly to FIG. **3** of the drawings, the cable **50** is generally depicted in cross section. The cable **50** is composed of a plurality of wires **60** which are preformed and twisted in a first direction to form strands of wires **62**. For example, there are **19** individual wires **60** within each strand **62**. However, this number can be readily varied. Also, there are shown to be seven strands **62** within the cable **50**. The strands themselves are preformed and twisted to form the cable **50**. The direction of the twist of the strands **62** is opposite to that of the twisting of the wires **60**. As a result, the overall cable structure remains tightly twisted and resists separation of the wires and strands. A plastic sheath or jacket **64** surrounds the twisted strands of the cable **50**. The plastic sheath **64** is tightly molded to the twisted cable strands **62** so as to help prevent untwisting of the cable when the cable is pulled to a substantially straight configuration. Therefore, the orientation is maintained of the stretched portion of the cable **50** as opposed to the unstretched portion which assures that the structure will recoil when the load is removed.

The length of the cable **50** can be readily varied as determined by the particular application. However, when used as a small vehicle locking apparatus, the cable will normally be produced in 4 to 6 foot lengths. Loops **66** have been found to be suitable at the free end of each length of cable. The loops **66** are formed through the binding of the cable upon itself by means of a collar **68**. The length of the collar **68** is considered to be critical since a long collar permits easier cutting of the cable within the collar than does a shorter collar. It has been found that a short collar which is attempted to be cut would easily separate into two pieces and will not provide additional support for the cable under the action of a cutting apparatus such as a bolt cutter. Therefore, a collar length of usually no more than three time the bare cable diameter is desirable.

The particular size of wires **60** is to be found to also be significant. For example, the desirable size of the wires **60** is to be of substantially between 0.005 and 0.012 of an inch. Twelve thousandths of an inch is equal or less than the closed clearance of the jaws of a standard bolt cutter **70**. Thus it is apparent that the bolt cutter **70** will miss some of the wires during the cutting operation. The small wire size also allows the bundle of strands to flatten out rather than be cut by the pressure of the bolt cutter, see FIGS. **7** and **8**.

In a standard three-eights inch diameter cable, the individual wires are larger and a bolt cutter will be able to cut a larger wire more quickly. In a standard one-eight inch diameter cable the individual wires are smaller but can be more easily cut by hand tools. While the bolt cutter **70** will not cut wires of one-eighth inch diameter cable, the cable can be easily bent to cause the wires to break in fatigue because not enough uncut wires remain.

It has also been noted that the twist of the strands **62** and of the wires **60** within each strand is directly related to the size of the final helical coil. In other words, by changing the twist of the strands or of the wires prior to bending, the tightness of the coil bundle can be controlled.

Referring particularly to FIG. **6** of the drawings, there is shown a seat assembly **12** of a small vehicle such as a motorcycle or bicycle. Normally such seat assemblies include a mounting shaft **74** which is connected to the frame **76**. Usually beneath the seat **78** of such seat assemblies **72** is some kind of a bracket **80**. The coiled cable **50** of this invention can be readily stored upon the bracket **80** by means of a padlock **82**. The padlock **82** can also function as a locking mechanism to lock together the ends of the cable **50** when connecting the vehicle to a fixed object.

The coiled cable **50** of this invention has a most pleasing appearance when not in use. Since the size of the coiled cable is only 10 to 20 times the cable diameter, the bulk of the coiled cable is substantially reduced. In the preferred form the coiled cable is formed from 3/16 inch diameter cable consisting of seven strands of wire and these are six coil turns each having a diameter of about 3½ inches. A coiled 6-foot length of cable of this invention weighs approximately 7 ounces and it coils itself up like a telephone cord and hangs neatly under the seat **78**. The plastic cover **64** functions not only to prevent the cable **50** from untwisting but also to protect the finish of the vehicle to which it is being applied so as to not scratch such.

The cable of this invention can be readily employed with a cylinder type of padlock instead of with a conventional type of padlock. Also, other types of locks can be readily employed. The break strength for the preferred cable described above is approximately 4,000 pounds. This is quite high which makes the cable of this invention extremely difficult to cut. Also, anyone attempting to cut the cable of this invention by means of a hack saw, will find such extremely difficult to do because of the flexibility of the cable. It has been found that on the average it takes from 10 and 20 times longer to cut the cable of this invention with hand tools than to cut a hardened chain which can be easily cut with bolt cutters in two simple cutting movements.

When actual tests were conducted, it took a bolt cutter 130 seconds to cut the cable **50** of this invention where the same bolt cutter cut a case hardened chain which is normally used as a bicycle lock in two seconds.

What is claimed is:

1. A cable comprising:

a plurality of separate strands, said strands being preformed and twisted together in a first direction, each of said strands formed of a plurality of separate wires, said wires within each strand being preformed and twisted together in a second direction, one longitudinal side of said wires being stretched so that said cable assumes a natural helical configuration; and

means surrounding said cable to prevent said cable from becoming untwisted when said cable is caused to assume a substantially straightened configuration.

2. The cable as defined in claim **1** wherein:

said wires forming said cable to be constructed of a metallic material and of a diameter substantially between 0.005 and 0.012 of an inch.

3. The cable as defined in claim **1** wherein:

said first direction being clockwise, said second direction being counterclockwise.

4. The cable as defined in claim **1** wherein:

said means comprises a covering of material surrounding in a tight fitting manner said cable.

5. The cable as defined in claim **4** wherein:

said covering comprises a plastic sheath.

6. The cable as defined in claim **1** wherein:

each of the ends of said cable terminating in a loop, a collar connected to said cable to hold said cable into the loop, said collar having the length of less than three times the bare cable diameter.

7. In combination with a separate locking apparatus such as a padlock, a cable adapted to secure a movable article to a fixed article by being wrapped about a portion of both said articles, said cable terminating in loops, said loops to be connected together by said locking apparatus, said cable comprising:

a plurality of separate strands, said strands being twisted together in a first direction, each of said strands formed by a plurality of separate wires, said wires within each strand being twisted together in a second direction, said first direction being opposite to said second direction, one longitudinal side of said wires being stretched so that said cable assumes a natural helical configuration;

means surrounding said cable to prevent said cable from becoming untwisted once said cable is caused to assume a substantially straightened configuration, said means comprises a plastic covering placed in a close fitting relationship about said cable.

8. The combination as defined in claim **7** including:

said loops being formed by a collar connected to said cable at each end thereof, each of said collars being of a length less than one-half of an inch.

9. The method of making a cable comprising:

twisting a plurality of separate wires together in a first direction to form a strand;

twisting a plurality of separate strands together in a second direction to form a cable; and

stretching one side of the cable along its entire length so that the portion of the wires along said one side are caused to permanently deform by exceeding the yield point of the particular material of construction of the cable, thereby causing the cable to assume a natural coiled configuration.

10. The method as defined in claim **9** wherein the first twisting step is accomplished in a direction opposite to the second twisting step.

11. The method as defined in claim **9** wherein after the second twisting step the additional step is accomplished of covering the cable in its natural configuration.

12. The method as defined in claim **11** wherein the step of covering is accomplished by placing of a cover about the cable in a close fitting relationship when the cable is in its natural configuration.

13. A cable comprising;

a plurality of separate strands, said strands being preformed and twisted together in a first direction, each of said strands formed of a plurality of separate wires, said wires within each strand being preformed and twisted together in a second direction, one longitudinal side of said wires being stretched so that said cable assumes a natural helical configuration when at rest.

14. The cable as defined in claim **13** wherein:

said wires forming said cable to be constructed of a metallic material and of a diameter between 0.005 and 0.012 of an inch.

15. The cable as defined in claim **13** wherein:

said first direction being clockwise, said second direction being counterclockwise.

16. The cable as defined in claim **13** wherein:

means surrounding said cable to prevent said cable from becoming untwisted when said cable is caused to assume a substantially straightened configuration.

17. The cable as defined in claim **16** wherein:

said means comprises a covering of material surrounding in a tight fitting manner said cable.

18. The cable as defined in claim **13** wherein:

each of the ends of said cable terminating in a loop, a collar connected to said cable to hold said cable into said loop, said collar having a length of less than three times the bare cable diameter.

19. A locking apparatus for locking together two articles to prevent substantial movement of one relative to the other, said apparatus comprising:

a cable adapted to interconnect each of said articles, said cable constructed of a plurality of separate preformed and twisted strands;

said cable having a loop at each end adapted to receive a locking means placed through both of said loops;

said cable when at rest comprising a plurality of self coiling helical coils located between said loops in order to shorten the distance between said loops when said device is not in use; and

said helical coils permitting said loops to be extended apart a distance substantially that of the total cable length in order to extend said cable the distance to interconnect said articles so that said loops are located adjacent one another for receiving said locking means.

20. The locking apparatus as defined in claim **19** wherein:

each of said strands formed of a plurality of separate wires, one longitudinal side of said wires being

stretched so that said cable assumes the helical coiled configuration when at rest.

21. The locking apparatus as defined in claim **20** wherein:

means surrounding said cable to prevent said cable from becoming untwisted when said cable is caused to assume the extended configuration.

22. The locking apparatus as defined in claim **20** wherein:

said means comprises a covering of material surrounding in a tight-fitting manner said cable.

23. A locking apparatus for locking together two articles to prevent substantial movement of one relative to the other, said apparatus comprising:

a cable adapted to interconnect each of said articles, said cable constructed of a plurality of separate preformed and twisted strands;

said cable having a loop at each end adapted to receive a locking means placed through both of said loops;

said cable when at rest comprising a plurality of self-coiling helical coils located between said loops in order to shorten the distance between said loops when said device is not in use;

said helical coils permitting said loops to be extended apart a distance substantially that of the total cable length in order to extend said cable the distance to interconnect said articles so that said loops are located adjacent one another for receiving said locking means; and

covering means surrounding said cable.

24. The locking apparatus as defined in claim **23** wherein:

said covering means comprises a covering of material surrounding said cable in a tight-fitting manner.

25. The locking apparatus as defined in claim **23** wherein:

said wires forming said cable to be constructed of a metallic material and of a diameter within the range of 0.005 and 0.012 inches.

26. The locking apparatus as defined in claim **24** wherein:

said wires forming said cable to be constructed of a metallic material and of a diameter within the range of 0.005 and 0.012 inches.

27. The locking apparatus as defined in claim **19** wherein:

the diameter of said cable being substantially three-sixteenths of an inch.

28. The locking apparatus as defined in claim **19** wherein:

each of said strands formed of a plurality of separate wires, said strands being preformed and twisted together in a first direction, said wires within each of said strands being preformed and twisted together in a second direction, said first direction being clockwise and said second direction being counter-clockwise.

29. The locking apparatus as defined in claim **19** wherein:

collar connected adjacent each said end of said cable to hold said cable into said loop at each said end, each of collars having a length of less than three times the bare cable diameter.

* * * * *