

A BARRIER SYSTEM

TECHNICAL FIELD

- 5 This invention relates to a barrier arrangement, a system of a type that can be useful for balustrades, barriers alongside stairs, swimming pool enclosures and other similar applications, also a kit of parts to construct such a barrier or balustrade system or arrangement and a method of constructing such a barrier or balustrade system or arrangement.

10 BACKGROUND

It is currently well known to use a wire or wires extending between upright posts to act as a barrier.

- Generally, such wire or wires extend horizontally although for an example such as a stairway, such wire or wires would be expected to follow the slope
15 of the stairs, but nonetheless follow in a more or less parallel way an uppermost handrail which may in some cases be at an inclined angle to the horizontal.

- Conventionally there are a number of wires spaced one above the other which are then each strung between upright posts or in some cases, passing
20 from an anchor post through a further one or more posts to an anchor post at an opposite end of the wire.

- Each wire length is conventionally looped at one end to a thimble and then swaged with the swaged loop passing through a D-connector which in turn is secured to the anchor post, and at an opposite end, the wire is secured to its
25 end also as a loop to one end of a turn-buckle where an opposite end of the

- 5 turn buckle is also then secured to a D-connector secured to the further anchor post.

The wire barrier is made up of many fittings and tension adjusters such as turnbuckles, making it very time consuming to install; also all fittings and tension adjusters are visible and where a wire end is looped and swaged
10 there is a cut end which may project as a tail from the loop and this can be very sharp and catch skin and clothes rather nastily. Also the length of wire that needs to be cut needs to be very accurately cut to length because a turnbuckle may typically have only quite a small adjustment range (50mm might be typical).

- 15 A further significant problem with such an arrangement or system is that the wires extend in the case of a balcony balustrade typically, horizontally and can therefore act as steps for a child to climb up and over the balustrade or barrier.

In the case of a barrier along the side of a stairway, it is more difficult for such
20 longitudinally extending wires to be used as steps with an incline usually of 30 degrees but they can be used especially adjacent an upper side of a vertical post where a wire projects from them, leaving thereby an appropriate cradle for a foot for a climbing child.

A simple concept of stringing wire may be a method so that its effective parts
25 for barrier purposes are vertical or substantially vertical which reduces the problem of providing a supporting step for a child but this introduces a number of practical problems.

In one case, a turnbuckle could be used for each vertical wire to effect a tensioning of the respective wire.

- 5 The problem is seen as two fold namely cost and appearance.

The room needed for a turn-buckle and then respective swaged loops in wire to have a connection, means that if a barrier is one metre in height then as much as one quarter of the height might be taken for a practical installation having the loops and turnbuckles and connectors. Further, the cost of
10 turnbuckles typically of stainless steel for practical longer-term maintenance is such that it is a very high cost process. However, it is also very time consuming in construction and perhaps worst of all, the appearance of a number of turnbuckles as well as the tails of swaged ends of wires for each turnbuckle is not considered especially pleasing and these can also be
15 dangerous for raw ends of wire projecting out from a joint. If they are covered this then introduces a cover that would inherently require a cover of substantial height and also a possible higher step from which a child may launch to climb over the barricade.

Another approach that has been considered but again has not been
20 considered viable has been to thread a single continuous wire through matching apertures in a top and lower railing so as to thread the wire from a first anchor point through an aperture in a first railing, communicating with a second aperture in the same railing displaced from this first so that the wire then passes vertically downward to an aperture in a lower railing from where it
25 is then fed along the railing to a further aperture spaced apart along the length of the lower railing to rise again and so on. Such an arrangement can then have a single turnbuckle tightening which presumably, if it is one only, would not be so unsightly. Again also the turnbuckle tension adjustment range makes this impractical.

- 30 The problem here, however, is that in arranging such an interlacing in a practical sense would incur considerable friction as the wire is tightened so

5 that tension at one end would not be able to be easily transmitted right through the length of the wire so interleaved.

This friction could possibly be relieved however, by introducing pulleys but by doing so we immediately have another set of problems which is that the pulleys themselves are expensive, they necessarily take up significant space
10 and again become therefore either unsightly in their own right or cause shielding to be significantly larger than might be considered desirable from a visual point of view.

US patent no 6,135,424 illustrates where the single continuous wire is tensioned by pulling the cable taut between the rails is an example which
15 suffers from this difficulty in that the continuous wire may be not easily shift in its position relative to the rails when tensioned.

US patent no. 505,781 suffers from the shortcoming that the wires are exposed along the top rail. This produces an aesthetically unpleasing result. Furthermore, the exposure of the wires on the top rail may be uncomfortable
20 on the hand of a person.

All of the above description is intended to illustrate the problems being faced currently by the inventor in developing this invention and describes some of the ideas considered previously and the purpose for the invention but are not given for the purpose of indicating that any of these techniques are currently
25 being used or are in any way accepted or admitted as being commonly known techniques or are common general knowledge in Australia or anywhere else in the world.

It is an object of the present invention to address at least some of the aforementioned disadvantages.

Summary of the invention

In accordance with this invention according to one aspect there is a barrier arrangement or system with substantially vertical or at least approximately vertical wires or their equivalent being, at least, in the main, a plurality of
10 separate lengths of wire which each have respective ends anchored at a spaced apart position secured either directly or indirectly to a one or both of upper and lower railings of a barrier.

This is achieved in one case by having a loop thus formed engaged with a spreader adjacent an opposite side of the barrier with means to use the
15 spreader so as to effect tension in both legs of the wire at the same time.

In preference in the preceding case the spreader or connector provides a dual tensioner as both legs of the wire can be tightened at the same time.

In an alternative case, the ends of a respective wire are caused to be bulbous for instance as a lugged end and at a lower position interlock with a bracket at
20 a location spaced transversely distal to a central axis of a threaded shaft with a mutually effective tightening member effective to tighten the wire as between upper and lower railings.

In preference, a nut which is threadably screwed to a bolt can be used to apply tensile pressure where the bolt is itself anchored by being threaded to a
25 lower railing.

An advantage of this arrangement is that by using a spreader being either a spreader bracket or plate which can hold the respective leg or legs of the wire

5 apart a distance (or a similar distance in the case of the two legs) to the
distance apart of their respective ends where these are held with respect to
an upper railing, means that the tension can be applied firstly by an economic
device, and also a device that can be installed in a way that can be used with
a very low profile. The tension adjustment is also then able to provide easily a
10 greater range giving far more flexibility for wire length accuracy that was
previously needed.

In preference, the respective ends of the single wire length are arranged so
that they can both interlock with a respective one and other of the railings.
This is preferably by being passed through a slot in an under or lower side of
15 the upper railing and then being shifted to a position where an aperture is
then of a shape which allows for the wire to pass through but will intersect the
bulbous end.

Such a shape includes a shape which may be referred to as a key hole shape
where there are two interconnected apertures one of which is larger than the
20 other and where the larger aperture is chosen to have a sufficiently large
diameter to allow a bulbous end of a wire to pass there through but with the
other connected aperture to be of smaller diameter which is chosen to effect
an intersection so that the bulbous end of the wire will not pass through. The
bulbous end or swaged end is securely fixed to the under or lower side of the
25 rail when pushed to one side and in a preferable further feature a plug being
of typically rubber or plastic is used to close any remaining open area and it
also stops the bulbous end from releasing before tension is applied.

In a broadest sense it is possible to connect an end of the respective wire
end to an upper railing by having this looped through or be attached to the
30 railing through a connector such as a D shaped connector. If interlocking,
then each end can have a bulbous end for instance with a clamped ferrule

- 5 around its end which may be referred to as “lugged” that passes through a larger aperture portion of a keyhole shape and is wider than a smaller aperture of the keyhole shape.

In one form then the invention can be said to reside in barrier comprising an upper railing and a lower railing, and at least one narrow elongate band but
10 no more than two substantially vertical portions which are positioned to be parallel one with respect to the other, the at least one narrow elongate band being a separate single length of narrow elongate band with thereby two only respective ends, each end anchored at a position which is spaced apart the position of one end being different from the position of the other end, one end
15 being secured either directly or indirectly to a one of the railings and the other end being secured to the same or the other of the railings and there being means to effect a tensioning of respective substantially vertical portions with a tightening arrangement that is adapted to effect tensioning from a tightening means that has its tightening means location that is offset from being in line
20 with a direction of elongation of the one or, in the case of two substantially vertical portions, both of the vertical portions.

In a further form then, the invention can be said to reside in a barrier having an upper elongate member, a single length of wire having a first end
25 engaging and being anchored at a first location with the upper member by an interlocking effect, and a further portion of the wire intersecting a tensioning spreader connector located and connected to a lower railing, and adjustable means arranged to effect, by movement of the tensioning spreader connector away from the upper elongate member, tension in the respective portion or
30 portions of the wire between the spreader connector and the upper elongate member.

- 5 In preference the offset is effected by a spreader.

In preference the at least one wire has two only substantially vertical portions and includes therebetween a loop engaged with a spreader with means adjustably attaching the spreader to a one of the railings and the respective ends of the one wire are each attached to the other of the railings.

- 10 In preference the spreader is attached to a lower member by an adjustment means which includes means adapted to effect a dual tensioning with both legs of the wire being adapted to be tightened at the same time.

- In a further form then the invention can be also said to reside in a barrier having an upper elongate member, a single length of wire having a first end engaging at a first location with the upper member, and a second end of the wire engaging at a second location with the upper member which second location is displaced along the length of the upper member from the said first location by a selected distance, and a loop thus formed within the wire and being the wire portion between the first and second locations interengaging with a tensioning spreader connector, and adjustable means arranged to effect by movement of the tensioning spreader connector away from the upper elongate member, tension in the respective portions of the wire between the spreader connector and the upper elongate member.

- 25 In preference, the tensioning spreader holds the wire loop so that respective legs of the wire loop emanate from the spreader at a distance apart which is substantially the same as the said selected distance which is to say the distance each end of the wire is separated where attached to the upper elongate member.

5 Such an arrangement facilitates an arrangement where wire extends between the upper elongate member and the spreader in a direction where the alignment is vertical or approximately vertical and with an opportunity to keep costs low and have a very low profile and at a cost that can be very reasonable.

10 It is envisaged that there can be a single wire extending only between an upper railing and a lower railing. In such a case the connection to the lower railing can be by a one or more wires having their upper ends each held by interlocking with an upper rail and their lower ends each interlocking by intersecting with an interlocking shape in a plate or bracket which itself is
15 attached to a lower railing by at least one shaft having a screw threaded upper end and a compatible female threaded member to effect a tightening of the bracket and thereby the interconnected wire end or ends with respect to the upper railing.

A low profile is achieved by having the wire end intersecting with a bracket at
20 a location which is offset to a side of the axial center of the shaft. Also by using a simple well-established technique of having a lug on the end of the wire this allows also for a displacement that can be efficient in space requirements.

Also by having an upper railing with interlocking shapes as described means
25 that these can provided a very clean appearance for the barrier as a whole.

In preference, the respective ends of the wire each have a bulbous for instance as a lugged end which is arranged to pass through a larger of a connected aperture and interlock with engaged tension a smaller of the interconnecting apertures.

- 5 In preference such a bulbous end can be by reason of a ferrule crimped around an end of the wire.

In preference, the interconnected apertures are in a form conventionally known as a keyhole shape where there are two interconnected apertures with one smaller in diameter than the other and with the bulbous for instance as a
10 lugged end having a size that will pass through the larger diameter and not the smaller diameter.

In preference, the upper elongate member or railing is hollow, and there are a plurality of apertures preferably of keyhole shape through a lower side of such a member providing the interlocking shape.

- 15 In preference, the tensioning spreader connector is an elongate member having a central aperture through which a threaded member passes and which is engaged by a threadably engaging member arranged to effectively apply tensioning pressure on the tensioning spreader connector which in turn then applies tension to the wire loop.

- 20 In preference, the connector includes, at each end, a shape through which or into which the wire loop inter-engages.

In preference, in an arrangement with an upper railing, there is a lower railing to which each of the threaded members is threadably engaging.

- In preference, the lower railing can in one case be directly affixed to a floor or
25 base or can be secured by being secured at each respective end to upright posts or the like. This railing can then in a preferred form be an angled steel section, predrilled with spaced apart threaded apertures to receive the respective threaded shafts.

- 5 In preference, there can be provided a cover with apertures through which respective ends of the respective individual lengths of wire can be threaded so that the cover then can be located to the extent over and around the tensioning arrangement including each spreader connector. This spreader cover conceals all the tension mechanism, but can be easily lifted if further
10 tensioning is required.

An advantage of the invention is that such a cover, in practise, can be of relatively low profile thereby contributing to a very clean appearance of a finished barrier, be this a balustrade or the side of a stairs or any other application.

- 15 While reference has been made to the word "wire", it is intended that this term should be interpreted broadly or at the least to include elongate pliable members that could perform the same task.

Single or multiple strand wire, plastic coated wire, and even chain can be considered as exemplary of the scope intended for the word "wire" in its
20 broadest concept where the context admits.

In the preferred example, which shall now be described, the "wire" is a multi-strand wire of stainless steel strands.

- In a further form of this invention this can be said to reside in a kit of parts which includes an upper railing including a plurality of spaced apart apertures,
25 at least one length of wire which is bulbous at each end, a lower railing adapted to have attached to it at spaced apart intervals means to inter-engage or attach to a threaded shaft, a plurality of threaded shafts adapted to inter-engage with or be attached to the lower railing, at least one tension spreader connector having an aperture through which the threaded shaft is

5 adapted to pass, the connector being adapted to inter-engage with the wire to effect a tension in the wire, and a nut or other threaded member adapted to be engaging the thread of the shaft and effect a capturing of the connector to apply tension through this to an inter-engaged wire.

In a further form of this invention this can be said to reside in a method of
10 effecting a barrier with vertical or substantially vertical wires between an upper and lower railing which method includes the steps of effecting an interlocking of an upper end of a wire with a bulbous end with respect to the upper railing, and inter-engaging a lower portion of the wire with a tension spreader connector which is held to the lower railing by engaging with a
15 threaded shaft and threaded nut, and then tightening the nut to effect a tensioning of the wire thereby.

In a further form the invention can be said to reside in an adjustable barrier comprised of plurality of spaced bands of narrow elongate material, with two adjacent bands being formed from a single piece of the narrow elongate
20 material, said piece of material being doubled over with secured ends and extending through or around a spacer means which is adjustable to adjust the tension in the bands.

For a better understanding of this invention it will now be described with reference to embodiments which shall be described with the assistance of
25 drawings, wherein

Figure 1 is a perspective view of a balustrade system in accordance with a preferred embodiment of the present invention;

Figure 2 is a side view of an alternative tensioning device which may be used in the balustrade system of figure 1;

- 5 Figure 3 is a perspective view of alternative use for the components of the balustrade system shown in figure 1;

Figure 4 is a side view of a balustrade/fence system according to another preferred embodiment of the present invention;

Figure 5 is a side view of a staircase balustrade;

- 10 Figure 6 is a side view of an alternative staircase balustrade;

Figure 7 is a side view of a balustrade/fence system according to yet another preferred embodiment of the present invention;

Figure 8 is a detailed view of B of figure 7;

Figure 9 is a cross-sectional view through A - A of figure 8;

- 15 Figure 10 is a detailed view of C of figure 7;

Figure 11 is a perspective view of an alternative form of adjustment mechanism compared to that shown in figure 8; and

Figure 12A - 12 C are views of yet another form of adjustment mechanism.

Fig 13 is a perspective view of a barrier according to a further embodiment,

- 20 Fig 14 is a perspective view of a portion of that barrier being the further embodiment with a lower cover lifted to expose respective tension spreader connectors,

5 Fig 15 is a side elevation of the same barrier as in Figs 13 and 14 in this case the respective tension applying connectors being shown in dotted outline,

Fig 16 is an enlarged view in cross-section illustrating the tension applying connector being held by a nut engaging a threaded shaft which is itself threadably engaging a lower railing,

10 Fig 17 is a plan view of this same embodiment from a cross section passing above the lower tensioning arrangement

Fig 18 is a side elevation in relation to this further embodiment showing how in this embodiment a post is positioned and secured to a lower railing,

15 Fig 19 is a side elevation illustrating the way in which posts are joined to the lower railing,

Fig 20 is a side view of a plurality of vertical wires where the upper end which is lugged in each case is shown positioned inside the upper railing,

20 Fig 21 is an inside view of an upper railing in relation to this further embodiment showing in perspective the way in which a wire is interlocking with the upper railing by having a lugged end and which is caused to be located in a smaller end of a keyhole type slot in a lower wall of the upper railing,

Fig 22 is a perspective view of a second further embodiment where the barrier is provided for a stairway,

25 Fig 23 is a side view of the second further embodiment of the invention applied to the balustrade of a stairway where the tension spreader connectors are each shown in dotted outline together with the hold-down bolts ,

5 Fig 24 is a cross-sectional view in plan of a third further embodiment in which there is a further tension spreader connector so that from the same threaded bolt, three wires can be pulled down in tension with however, also the same very low profile characteristic,

Fig 25 is a side elevation in cross-section of the third further embodiment as
10 shown in Fig 24,

Fig 26 is a cross-sectional view in plan according to a fourth further embodiment in which there is a tension spreader connector with only one wire held in interlocking relationship,

Fig 27 is a side elevation of the fourth further embodiment showing both the
15 tension spreader connector applying tension to a single length of wire where this provides a single vertical portion only and where an upper end is interlocking with an upper railing as in the previous embodiment,

Fig 28 is a plan view of a fifth further embodiment in which the tension spreader connector is interlocking with two independent wires where each
20 wire has an upper and lower end lugged and in which the lower end is interconnecting with the connector at a spaced position to a side of a tensioning threadably engaging member, and a second of the wires in an oppositely positioned location to the said first and both having their respective ends in interlocking relationship with the upper rail. and

25 Fig 29 is a side elevation of a cross section of the fifth further embodiment as shown in Fig 27,

For this description the use of the term "narrow elongate band" is intended to be a broad reference which will include single and multi-strand wire. In

5 relation to the reference to "a single piece being doubled over" it was intended to mean that there would be two legs of substantially the same length which can be a result from doubling the band over but having of course a portion that extends through or around a spacer which then acts as a spreader and provides the offset alignment which allows for a reduced profile
10 feature.

The spacer or spreader is described as a spacer plate in one case or a spacer in another but has for its purpose to provide a tensioning arrangement which effects an interlocking location for the wire which is laterally offset to a threaded shaft which has a female member such as a nut that can be
15 tightened to apply tension. This provides for a very economic as well as a low profile tensioning system. The wire (or narrow elongate band in a broader description) is caused to be interlocking with the spacer at least one off set position to an axial center of the threaded shaft.

Also we have proposed that open apertures can be closed with appropriate
20 plugs both to retain in one case a bulbous end in location at a smaller end of a keyhole slot while erecting the assembly before tension is applied and also to keep insects out of hollow cavities and in another case simply to keep the appearance cleaner.

Figure 1 illustrates a balustrade system 10. The balustrade system 10 is
25 mounted to the edge of a structure such as a deck 14. The balustrade includes spaced members 12 between which a module 16 is mounted. Alternatively, the module 16 is mounted between a post member 12 and an upright 15 forming part of the structure 14. The module 16 is in the form of an upper rail 18 and a lower rail 20. Bands 22 of narrow elongate material such as wire extend between the two rails 18, 20. Each band 22 constitutes a
30 separate piece of wire with its ends fixed by welding or a fastener to the rails

5 18, 20. In the embodiment shown, the bands are made up of a number of wires whereby each wire forms two bands by threading the wire through to apertures 42 provided in the lower rail 20. The units of rails 18, 20 and wires 22 may be prefabricated prior to transportation to the site where they are to be installed. Additionally, the modules 16 include a cover 24 with an
10 elongated slot 26 extending along its length. The slot enables the cover 24 to slide over the rail 18. In the prefabricated module 16 which is brought to the site, the cover may be assembled with the upper rail 18 or alternatively may be separate therefrom and assembled in situ.

On site, the balustrade is assembled by installing the post members 12 at
15 regular spaced locations along the edge of the deck 14. In the embodiment shown, the lower rail 20 is secured to the deck 14 by means of fasteners 28. The post member 12 is provided with a coupling in the form of spigot 30 to project into the end of the cover 24.

The post member 12 also includes a tensioning device 32 in the form of a
20 thread adjuster which has a rotatable plate 34 to raise the upright portion 36 of the post member 12 to thereby raise the spigot 30. Initially, the position of the spigot 30 is such that assembly with the cover 24 allows a degree of slack in the wires 22. The tensioning device 32 is then operated to raise the spigot 30 and tension the wires 22. A similar post member 12 is provided at the
25 other end of the module 16. However, in figure 1 a dedicated tension device 38 is secured to the upright 15 of the structure. This tensioning device 38 includes a spigot to assemble with the cover 24 whereby the position of the spigot 40 is movable up and down relative to the upright 16.

While figure 1 illustrates that the lower rail 20 may be secured directly to the
30 deck 14, in another embodiment, a lower cover may be provided, similar to

5 the cover 24, with the cover able to be secured to lower spigots provided on respective spaced post members 12.

Figure 2 illustrates an alternative form of a tensioning device 44. The tensioning device 44 is incorporated into the upper end of a modified post member 12'. The post member 12' has a top plate 45 having an internal
10 aperture 43 to receive a bracket 46. The bracket 46 is T shaped having spigot portions 47 at each end of the upper part of the T while the lower part of the T is in the form of an externally threaded rod 49 which is matingly or cooperatively received in the threaded aperture 43. The spigot portions 47 are adapted to receive the ends of the covers 24. The tensioning device 44
15 also includes a height adjusting nut 48 which may be rotated by the installer to move the bracket 46 upwardly and thereby tension the wires 22.

Figure 3 shows the versatility of many of the components used in the balustrading system of figures 1 and 2. Like numerals represent like parts. In the balustrade of figure 3, the spaced post members 12' support the cover 24
20 in the manner explained in conjunction with figure 2. The post members 12' also support lower covers 24" in fixed disposition. The lower covers 24" are of the same form as the upper cover 24. Thus, the covers 24, 24" have opposing slots in which a glass panel 50 may be received.

Figure 4 illustrates an alternative form of the invention in which a
25 prefabricated module 16' is provided between two post members 12". The module 16' is comprised of two uprights 52, 54 having wires 22 extending therebetween. The uprights 52, 54 may each be comprised of an inner rail surrounded by an outer cover as with previous embodiments. Alternatively, the wires 22 may be directly secured to the uprights 52, 54. The upright 52
30 may be fixedly secured to one of the post members 12". The upright 54 may be movably secured to the other post member 12" with an adjustment device

- 5 58 being provided to facilitate movement of the upright 54 relative to the associated post member 12" to facilitate tensioning of the wires 22.

Figure 5 illustrates how the balustrade system may be adapted for use with a staircase 60. The balustrade system 10 can be adapted to a staircase provided appropriate angled couplings are provided between the post
10 members 12' and the upper and lower covers 24, 24'. However, in an alternative embodiment illustrated in figure 6, the lower rail 20 may be directly secured to the staircase structure.

Figure 7 illustrates another form of the fence/balustrade secured to a structure such as a deck 14. The balustrade is made up of spaced posts 70
15 which are connected via connectors 72 to an upper rail 74. A lower rail 76 also extends between the two posts 70. A plurality of bands 22 of narrow elongate materials such as wire extend between the two rails 74, 76. Each two adjacent bands 22 is formed from a separate piece of wire which is secured at its top ends as shown in figure 10 and doubled over in the vicinity
20 of the lower rail 76.

Figures 8 and 9 illustrate the configuration where the wire is doubled over. The wire 22 extends around a spacer plate 78. The spacing plate 78 is adjustably connected to the lower rail 76 by means of two spaced threaded rods 80. Adjustment nuts 82 are provided at the top of each of the threaded
25 rods 80. Their adjustment will affect the tension in the wire 22. Thus, two bands 22 of wire can be adjusted in tandem.

The adjustment mechanism comprising the spacing plate 78, threaded rods 80, adjustment nuts 82 may be covered by a cover plate 84 which is semi-cylindrical as shown. The cover plate 84 has spaced holes to allow the wire to
30 pass through. In addition, grommets may be provided to seal the holes and

- 5 prevent the egress of water into the adjustment mechanism. The cover plate 84 need not be semi-cylindrical and could be of a U-shaped cross-section.

As shown in figures 8 and 9, the lower rail 76 may be secured directly into the decking material of the deck 14 by screws 86 or like fasteners. Additionally, as shown in figure 8, a washer 88 may be disposed between the adjustment
10 nut and the spacing plate 78.

While the embodiment of figures 7 to 10 has been illustrated in terms of a fixed upper and lower rails 74, 76, the tandem adjustment feature could also be incorporated into any of the previous embodiments.

Figure 10 illustrates the form of the upper rail 74 and the connection of the
15 wires 22 thereto. The upper rail 74 is provided in the form of a stainless steel pipe having keyhole apertures 90 at spaced locations. The ends of the wires 22 are provided with lugged ends which may be received into the larger portion of a respective keyhole slot. Once inserted through the keyhole slots 90, the lugged ends are retained in the narrower portion of the keyhole slots
20 90. A plug may be inserted into the larger portion of the keyhole slot 90 to prevent removal of the wires 22.

Figure 11 illustrates a slightly modified form of the embodiment illustrated in figures 7 to 10. In this embodiment, the adjustment mechanism is provided with a single threaded rod 80' and adjustment nut 82'. The spacer plate 78' is
25 of narrow elongate configuration, the length of which sets the spacing between the two bands 22 of the single piece of wire.

Figure 12 illustrates a modified form of the embodiment illustrated in figures 7 to 10. In this embodiment, the lower rail 76' is in the form of a right angled section. Mounted to this angled section 76' are two guides 92 around which

5 the wire forming the two bands 22 extends. The wire is secured at its top ends in a similar manner to that shown in figure 10. Also mounted to the lower rail 76' is a tensioning wheel 94. The tensioning wheel 94 has two lugs which are approximately diametrically opposed. The wire extends between the two lugs. Rotation of the tension wheel 94 takes up any slack in the wire
10 and thereby increases the tension of the bands 22. A locking plate 96 is provided to secure the tension wheel 94 in the selected position. The bottom rail 76 may be secured the decking 14. Alternatively, it may be spaced from the decking and extend between two adjacent posts 70.

Now referring to the further drawings in detail and in particular to the further
15 embodiment as illustrated in Figs 13, there is a barrier 100 which is provided by a plurality of vertical wires shown typically at 101 which extend between an upper railing 102 and a lower railing 103.

There are a plurality of posts shown typically at 104 which are located at spaced apart intervals, the distance apart being selected to be appropriate to
20 have the plurality of wires 101 with in each case a vertical portion 118 able to be spaced apart both equally from one another and from an equal distance from the post at each end.

As can be seen in relation to the further embodiment in particular, the appearance of a barrier constructed according to this further embodiment
25 provides an extremely pleasing appearance where none of the interconnecting elements or tensioning elements are obviously visible and where a cover 105 can be located so as to cover the lower tensioning members but at the same time will not of itself provide a step which is substantially elevated to assist a young person to step up and over the barrier
30 or barricade 100.

5 Each wire in this case 101 is a leg of a single length of wire which is in the form of a loop where the respective ends of each single piece have a compressed lug shown typically at 106 which are positioned so as to be held in an interlocking position with respect to the upper railing and at a lower end the loop of the single length of wire is interlocking with a tensioning spreader
10 connector shown typically at 107.

In Fig 14 the tensioning spreader connector 107 has a central aperture 108, and at opposite ends and an equal distance apart from the central aperture 108 a slot 109 in one case and 110 in the other.

The wire 101 passes through the slot 109 to extend then beneath the
15 connector 107 to then exit upwardly through the slot 110.

A single threaded shaft 109 projects vertically from threaded engagement in threaded aperture 110 in a base plate 111 which itself is one side of a right angle member 112 where the other side is a vertical plate at 113.

There are a plurality of these upright shafts 109 which are located at spaced
20 apart position which might be termed a modular distance so that with a connector 107, the respective wires 101 will then be kept at a distance apart which is the same between respective wires or legs of the wires as shown especially in Fig 24.

Connector 107 is able to be tensioned by use of a nut 114 which is screwed
25 to tighten the tension by being screwed around the thread of the shaft 109.

In order to stop the connector 107 turning as the nut 114 is turned, it is arranged that each of the connectors 107 include rearwardly extending legs 115 which engage against the rear side of the lower railing 113.

5 In this embodiment, the elongate length defined by an inner end of each of the slots 109 and 110 plus the thickness of the wire 101 is equal to half the distance between the central axial centres of adjacent threaded shafts 109.

Such an arrangement is chosen so that in the arrangement shown in this embodiment, the legs of the wires 101 will then be a constant distance apart
10 at least where connected in this manner to the lower railing 103.

An advantage of this arrangement is that it can be achieved using components that need not be exotic and which can be prepared from steel and protected by appropriate coatings such as galvanising and by using the cover as shown at 116 this both protects the underneath materials and
15 maintains the good appearance.

The low profile is also achieved by having tension effected by an adjustable tension-applying device, eg the threaded shaft and a nut, being transferred laterally to the axial centre of such a shaft.

While the specific illustrations show a shaft 109 having a selected height, it is
20 understood that this height can in fact be reduced so that its length will provide a sufficient length for firstly the nut 114 to be able to be threadably engaging in the first instance 109 and thereafter to effect a sufficient tensioning and to some extent therefore stretching of the wire 101 without causing a lower surface of the wire 101 to engage the lower plate 111 before
25 a sufficient tension has been effected in the wire 101.

This is a factor that can be taken into account when selecting components but it can be seen that with the arrangement shown, a very low profile arrangement can be achieved.

5 In Fig 14, there is shown a cover 116 which is of U shape with the open mouth of the U shape in cross-section being lower-most and there being a plurality of apertures shown typically at 117 through which the respective wires 101 can be fed and so that the cover 116 can then fit so as to encompass the lower railing 112 and which can either be left in that position
10 loosely or it can be locked in position perhaps by means not shown but as an example a text screw mutually engaging between the respective parts.

We will describe the way in which an upper end of each of the wires 101 is interlocking with the upper railing 102 and it is an arrangement that each aperture 117 is big enough for a bulbous end to pass through such an
15 aperture and if subsequently appropriate, this can either be left wider or it can be filled with an appropriate filler or grommet which is not specifically shown in the drawings.

Each end of the wire 101 is bulbous in that there is then an ability to easily effect an interlocking effect with a slot or other appropriately shaped aperture.

20 The term "bulbous" is intended however, to indicate that there is a portion at or towards the end of the wire which is wider than a portion further from the end of the wire.

This then enables the bulbous portion to be ensnared or be intersected as compared to the narrower portion of the wire further from the end allowing
25 thereby an interlocking effect to be achieved.

In this embodiment as shown in Fig 21 a multi-strand wire is used which has compressed around its end 119 a lug 120.

- 5 This metal lug 120 relies upon the characteristics of the metal to hold this tight around the end 119 and with sufficient compression to ensure that an expected tension in the arrangement will not cause the lug 120 to dislodge from its compressed position around the end 119.

- 10 In order to get the lug in the interlocking position shown in Fig 21, and to ensure that the position as shown in an interlocking position will be relatively stable over a longer period, there is provided a keyhole slot arrangement 121 which includes a portion of broader diameter 122 and a portion of lesser diameter 123.

- 15 The portion of larger diameter 122 is of such a size as to allow the passage of the lug 120 in its compressed form as shown to pass through this, and there is a narrow neck 124 the distance apart however, being greater than that required to allow the wire 101 where it is not bulbous to pass thereby and of course the diameter of the smaller portion 123 is such that it will not allow the lug and with it the attached end of the wire 119 to pass thereby.

- 20 Such an arrangement is repeated as an aperture at spaced apart intervals along the lower side of the upper railing, which in this case is a hollow tube, and these keyhole slots which appropriately can be cut economically by for instance a laser cutter, can thereby provide an interlocking attachment for the respective ends of the wire 101.

- 25 The distance between respective ends 119 of wire 101 when in their appropriately positioned interlocking position with the smaller apertures 123 will be that distance which corresponds also to the distance by which the wire 101 is separated at the bottom allowing however, for the thickness of the wire so that the wires from their position at the bottom to the upper railing will be
30 substantially parallel.

- 5 There will of course be incidental variations to being strictly parallel to allow for manufacturing tolerances, the possibility that the connector 107 is slightly displaced to one side or another of the shaft 109 and so on.

However, the intention is to have substantially vertical parallel wires which will thereby not provide footholds for children and which will be able to provide a
10 very low profile tensioning system in a way which is both very practical and economic to put into place.

The lower railing 112 in this embodiment as specifically shown in Fig 16 is secured in a lowermost position by having hardened nails 125 caused to pass through the bottom plate 111 into a concrete floor 126.

- 15 In an alternate embodiment, there is a spacer between the bottom plate 111 and the floor 126 which therefore allow for drainage beneath the plate 111 if appropriate in the application.

While the securement is shown to, in this case, a concrete floor, it is, in a further embodiment, an arrangement where the ends are secured to, at each
20 end, an upright post.

In a further alternative, the lower railing, this being a right angular member is secured to a side stringer by having a mutually engaging holding member such as a screw passing through the back plate 113 and into the stringer.

In an alternate further embodiment, the lower railing 112 is secured to the
25 ends of joists.

As shown specifically in Fig 20 the upper railing 102 is a hollow metal member which is of continuous cross section along its length and which is

- 5 supported at each end by inter-engagement with a connector bracket 130 which is also supported by interlocking with an upper end 131 of a post 132.

The post 132 is secured in this case by a bracket 133 (Fig 19) so that a lower end of the post 132 sits upon the bottom plate 111 of the lower railing 112 and is held by being pinned to the back plate 113 of this.

- 10 We now refer to drawings Figs 22 and 23.

In this case, this illustrates how both the upper and lower railings can be inclined, for instance, to provide a barrier for stairs in which the upper railing is a handrail and how the concept of this invention applies very appropriately also to this arrangement.

- 15 The wires in this case shown typically at 140 are held by a tension spreader connector typically at 141 where the wires are in a loop with both otherwise free ends 142 being in an interlocking relationship with an upper railing 143.

- In this case, given that there will be tension on the respective lugged ends at 144, each keyhole slot which is included in spaced apart relationships along the length of the upper railing which is a hollow tube 143 are orientated so that the larger diameter portion of a keyhole slot is higher than the portion with the smaller diameter.
- 20

- Otherwise, there are spaced apart posts 145 which support the upper railing 143 and hold this against tension that will be applied by the lower tensioning arrangement which is substantially the same as that described in the earlier embodiment.
- 25

- 5 While the earlier embodiments have used an arrangement in which there are two legs of a single piece of wire with both free ends inter-engaging with an upper railing, this, in an economic construction technique, would result in the distance apart of the wires and the posts being such that there would be an even number of wires.
- 10 However, this is not always an appropriate arrangement in that there can be other lengths of barrier required and in order to be able to provide some flexibility, a further system includes a spreader connector which is appropriate for a single wire where an upper end of the wire is bulbous and is interconnected in the upper railing, but at the lower end is also bulbous and
- 15 interconnects with a further slot of a connector.

This is achieved then as shown in Figures 32 and 33 by having in the first instance, a connector 150 which includes oppositely positioned slots 151 and 152 which capture and provide an interlocking engagement in relation to wire 153.

- 20 However, in addition, a further connector 154 which has an aperture 155 through which shaft 156 extends and this is then threadably engaging with nut 157.

There is a width of this connector 154 so that there is an inner edge 158 which bears against an upright side 159 of the lower railing 160.

- 25 The connector 154 has at an outermost end 161 a slot 162 which defines by reason of its distance from an axial centre of the shaft 156 a distance which is $1 \frac{1}{2}$ times the modular distance allowing however, for the width of the wire, in this case a single wire 163.

- 5 This single wire 163 is arranged to be and provides a single vertical barrier portion with a lowermost like end 164 interlocking with the slot 162, and an upper lugged end 165 interlocking with the smaller diameter of a keyhole slot 166 as previously described.

- 10 The upper ends of the wire 151 and 152 lugged ends at 170 and 171 and these are interlocking with respective keyhole shapes 172 and 173 which are apertures in the lower surface of a hollow tubular upper ailing 174.

The shaft 156 is a threaded shaft and includes a threadable engagement with a lower plate 175 at 176.

- 15 While we have hitherto described an arrangement in which the tension-spreader connector engages the bottom of a loop of a single wire in which the wire is effectively doubled over, it is also possible to achieve the advantages of the invention by having at least in a broader sense the same arrangement in which there is a single wire which is indeed terminated with a bulbous end both at an upper end and at a lower end and this is arranged either to be held
20 by a connector which has an arrangement holding one only vertical portion as is seen in Figs 14 and 15, or where we have the balanced arrangement but instead of the wire being looped, there are two separate wires, each of which is terminated below a slot in opposed sides of a connector tension-spreader by having a bulbous end at the respective ends.

- 25 Referring specifically in the first case of figs 34 and 35, the lower railing 180 includes a threaded shaft 181 which is threadably engaged within a bottom plate 182 at 183.

This then supports the shaft for this to be extending vertically and this in turn supports connector-plate 184 which has an aperture 185 through which the

- 5 shaft 181 passes and at an outermost end there is a slot 186 through which the wire 187 passes and there is a lugged end 188 which stops this from releasing.

An upper end of the wire 187 is also lugged as in 190 and this fits with interlocking engagement through keyhole slot 191 as previously described.

- 10 The tension is supplied by a nut.

The sides of the aperture as with other brackets at 185 in the connector 184 is chosen so that it will freely slide along the length of the threaded shaft 181 but will not be so open so that when there is caused to be tension on the wire 187, by pushing down through the screwing of the nut 192, this will in effect
15 limit any extensive inclination of the connector plate 184.

The same situation applies in the further embodiment as now shown in Figs 28 and 29 except that the connector in this case 193 is substantially the same as that shown in the first embodiments, except in this case the two vertical wires are independent and each are terminated at their lower end by a lug,
20 these being shown at 194 and 195.

The same arrangements, however, apply in that there is a threaded shaft 196, a nut 197, and a distance apart from wire centre to wire centre at 198 and 199 which defines a modular distance which then is matched for a remainder of wires including the distance apart of the upper ends of the wires
25 shown at 200 and 201.

Again, the lower railing 202 is pinned by pins 203 and 204 to a concrete flooring 205.

- 5 While through the specification the description has referred to a threaded shaft, this can also be a bolt with a head beneath the lower railing and acting as a spacer between the railing and a lowermost floor.

Also with the shaft there is advantage in having a lower most thread terminating part way up the shaft and thereby providing a locking shape to
10 tighten the thread against.

Otherwise the features are as previously described especially in relation to the first embodiment and its alternatives.

What we have now described provides a way in which members can be economically be made and protected, for instance, either being made from
15 stainless or other self protective materials, or being coated appropriately, for instance by being galvanised or otherwise and the way of applying the tension means that this can be achieved in a way that allows for a very low profile technique while using components, for instance, a threaded shaft and a conventional nut and a spreader connector, which in this case is usually a
20 plate that can be punched into shape and there are means to keep the plate from twisting when the nut is being tightened by having the lower railing having a side plate which also provides a strengthening and stiffening of the lower railing and this also then provides for support for a cover.

5 CLAIMS

1. A barrier comprising an upper railing and a lower railing, and at least one narrow elongate band but no more than two substantially vertical portions which are positioned to be parallel one with respect to the other, the at least one narrow elongate band being a separate single length of narrow elongate band with thereby two only respective ends, each end anchored at a position which is spaced apart the position of one end being different from the position of the other end, one end being secured either directly or indirectly to a one of the railings and the other end being secured to the same or the other of the railings and there being means to effect a tensioning of respective substantially vertical portions with a tightening arrangement that is adapted to effect tensioning from a tightening means that has its tightening means location that is offset from being in line with a direction of elongation of the one or, in the case of two substantially vertical portions, both of the vertical portions.
2. A barrier as in the preceding claim where the offset is effected by a spreader.
3. A barrier further characterised in that the at least one wire has two only substantially vertical portions and includes therebetween a loop engaged with a spreader with means adjustably attaching the spreader to a one of the railings and the respective ends of the one wire are each attached to the other of the railings.
4. A barrier as in the immediately preceding claim further characterised in that the spreader is attached to a lower member by an adjustment means which includes is adapted to effect a dual tensioning with both legs of the wire being adapted to be tightened at the same time.

5 5. A barrier as in preceding claim 1 where the both ends of a respective wire are caused to be bulbous and at a lower position interengage with a spreader which holds respective part or parts of the wire at spaced apart location or locations transversely distal to a central axis of a threaded shaft arranged to be effective to tighten the wire as between upper and lower
10 railings.

6. A barrier as in the immediately preceding claim further characterised in that a nut is threadably screwed to a bolt which is adapted to be used to apply tensile pressure to a one or each substantially vertical portion or portions and where the bolt is itself anchored by being screwed or otherwise
15 affixed at a lower end to a lower railing.

7. A barrier as in any one of the preceding claims further characterised in that the respective ends of the single wire length are arranged so that they can both interlock with a respective one and other of the railings.

8. A barrier as in the immediately preceding claim further characterised in
20 that the wires are connected by being passed through a slot in a lower side of the upper railing and then being shifted to a position where an aperture of a keyhole shape which allows for the wire to pass through but will intersect the bulbous end.

9. A barrier as in the immediately preceding claim where the shape of
25 the aperture has two interconnected apertures one of which is larger than the other and where the larger aperture has a sufficiently large diameter to allow a bulbous end of a wire to pass there through and with the other connected aperture of smaller diameter such that the bulbous end of the wire will not pass through.

5 10. A barrier having an upper elongate member, a single length of wire having a first end engaging and being anchored at a first location with the upper member by an interlocking effect, and a further portion of the wire intersecting a tensioning spreader connector located and connected to a lower railing, and adjustable means arranged to effect, by movement of the
10 tensioning spreader connector away from the upper elongate member, tension in the respective portion or portions of the wire between the spreader connector and the upper elongate member.

11. A barrier having an upper elongate member, a single length of wire having a first end engaging at a first location with the upper member, and a
15 second end of the wire engaging at a second location with the upper member which second location is displaced along the length of the upper member from the said first location by a selected distance, and a loop thus formed within the wire and being the wire portion between the first and second locations interengaging with a tensioning spreader connector, and adjustable
20 means arranged to effect by movement of the tensioning spreader connector away from the upper elongate member, tension in the respective portions of the wire between the spreader connector and the upper elongate member.

12. A barrier as in either one of the immediately preceding claims where the tensioning spreader holds the wire loop so that respective legs of the wire
25 loop emanate from the spreader at a distance apart which is substantially the same as the said selected distance which is to say the distance each end of the wire is separated by horizontally where attached to the upper elongate member.

13. A barrier as in any one of the preceding claims where there is a single
30 wire extending only between an upper railing and a lower railing, the connection to the lower railing being by a one or more wires having their

5 upper ends each held by interlocking with an upper rail and their lower ends
each interlocking by intersecting with an interlocking shape in a plate or
bracket which is acting as a spreader which itself is attached to a lower railing
by at least one shaft having a screw threaded upper end and a compatible
female threaded member to effect a tightening of the bracket and thereby the
10 interconnected wire end or ends with respect to the upper railing.

14. A barrier as in any one of the preceding claims further characterised in
that the bulbous end is effected by being a ferrule crimped around an end of
the elongate narrow band.

15 15. A barrier as in any one of the preceding claims further characterised in
that the lower railing is in one case directly affixed to a floor or base or is
secured by being secured at each respective end to upright posts or the like.

16. A barrier as in any one of the preceding claims further characterised in
that this railing is an angled steel section, pre-drilled with spaced apart
threaded apertures to receive the respective threaded shafts.

20 17. A barrier as in any one of the preceding claims further characterised in
that a cover with apertures through which respective ends of the respective
individual lengths of wire are threaded so that the cover then can be located
to the extent over and around the tensioning arrangement including each
spreader connector.

25 18. A kit of parts which includes an upper railing including a plurality of
spaced apart apertures therein, at least one single length of wire which is
bulbous at each of its two ends, a lower railing adapted to have attached to it
at spaced apart intervals means to inter-engage or attach to a threaded shaft,
a plurality of threaded shafts adapted to inter-engage with or be attached to

5 the lower railing, at least one tension spreader connector having an aperture through which the threaded shaft is adapted to pass, the connector being adapted to inter-engage with the wire to effect a tension in the wire, and a nut or other threaded member adapted to be engaging the thread of the shaft and effect a capturing of the connector to apply tension through this to an inter-
10 engaged wire.

19. A method of effecting a barrier with at least substantially vertical wires between an upper and lower railing which method includes the steps of effecting an interlocking of an upper end of a wire with a bulbous end with respect to the upper railing, and inter-engaging a lower portion of the wire
15 with a tension spreader connector which is held to the lower railing by engaging with a threaded shaft and threaded nut, and then tightening the nut to effect a tensioning of the wire thereby.

20. An adjustable barrier comprised of a plurality of spaced apart bands of narrow elongate material, with two adjacent bands being formed from a single
20 piece of the narrow elongate material, said single piece of narrow elongate material being doubled over with secured ends being secured to a one of the barriers and extending through or around a spacer means which is adjustably held with respect to a second of the barriers to adjust tension in the bands.

21. An adjustable barrier as in claim 26 further characterised in that it
25 includes a plurality of such doubled over pieces of material, each of which is separately adjustable.

22. A barrier system including:

a module comprised of;

5 a first rail, a second rail and bands of narrow elongate material
extending between the first rail and the second rail;

and an elongate cover provided to extend over said first rail;

the barrier system further comprising two spaced post members
whereby at least one of the rails is movably mounted to at least one of the
10 post members to adjust the spacing between the rails and thereby the tension
in the bands.

23. A barrier system as in the immediately preceding claim further
characterised in that the module is assembled with each rail extending
between the two post members.

15 24. A barrier system as in the immediately preceding claim but one further
characterised in that the module assembled with each rail is secured to a
respective post member.

25. A barrier system as in the immediately preceding claims 22 or 23
where the rails are not directly connected to the post members.

20 26. A barrier system as in any one of the preceding claims wherein the
parts are in kit form with the bands of narrow elongate material wound
around or through one or both of the rails.

27. A barrier system as in any one of the preceding claims further
characterised in that the bands of narrow elongate material are selected from
25 any one of the following namely wire, wire rope, cable, metal or plastic ribbon,
cord, rope or chain.

28. A barrier system as in the immediately preceding claim further

- 5 characterised in that the bands are arranged in an equal spacing apart one from the other along a length of the upper and lower rails.

29. A barrier system as in the immediately preceding claim further characterised the bands are located so that they are a spaced apart from adjacent parallel bands by a distance which is for each the same.

- 10 30. A barrier system as in the immediately preceding claim further characterised in that the bands are positioned in spaced apart locations so that the barrier effect extends substantially the length of the rails to provide an adequate barrier.

31. A barrier system as in any one of the preceding claims wherein each
15 band is constituted by a separate piece of narrow elongate material.

32. A barrier system as in any one of the preceding claims further characterised in that there is an adjustment mechanism at one end of each band where each separate piece of narrow elongate material makes up two bands, and the adjustment mechanism is provided to adjust both bands
20 simultaneously.

33. A barrier system as in any one of the preceding claims wherein the end of each band is affixed to a one of the rails while a middle region of the band cooperates with the adjustment mechanism.

34. A barrier system as in any one of the preceding claims wherein the
25 lower rail is engageable with a floor or is part of a floor.

35. A method of assembling a barrier including: a first rail and a second rail with bands of narrow elongate material preassembled with the first and

5 second rails to extend therebetween;

installing spaced post members in their intended location; and

installing the module between the spaced post members, whereby at least one of the rails is movably mounted to at least one of the post members to adjust the tension in the bands.

10 36. A stair balustrade including:

a module comprised of: a first rail, a second rail and bands of narrow elongate material extending between the first rail and the second rail, the balustrade further including two spaced post members whereby at least one of the rails is movably mounted to at least one of the post members to adjust
15 the spacing between the rails and the tension in the bands.