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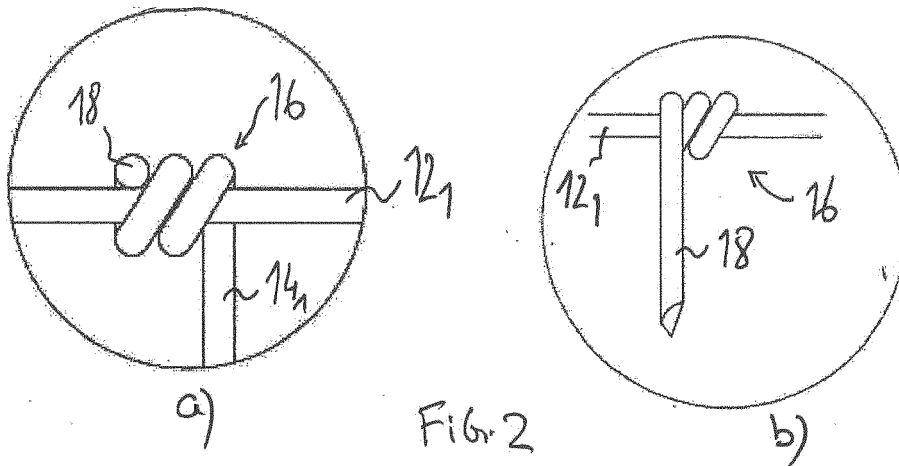
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(54) **BARBED WIRE FENCE**

(57) A wire fence comprises a plurality of wires (12, 14) arranged in an intersecting manner to form a multiplicity of apertures, wherein intersecting wires are connected by joints formed by a joining wire portion. In particular, the wire fence comprises lines wires (12) and stay

wires (14) connected by hinge joints (16, 20). At least part of the joints (16, 16') are configured in such a way that a free end (18) of the joining wire portion protrudes on one side of the fence, preferably substantially perpendicularly thereto, to form a barb end.



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Description

FIELD OF THE INVENTION

[0001] The present invention generally relates to wire fences and in particular to a wire fence as typically used for field fencing and animal containment. More specifically, the invention is related to a wire fence having sharp points, barb end(s), forming an aggressive part pointed out on one side of the erecting plane of the fence.

BACKGROUND OF THE INVENTION

[0002] As it is known in the art, fences are freestanding structure designed to restrict or prevent movement across a boundary. Fences are distinguished from walls by the lightness of their structure. Fences are largely used in agriculture but also elsewhere, where the divisions or subdivisions of areas become important.

[0003] Fences used outside in large fields are called field fences. There are various types of field fences amongst which wire fences and barbed wire fences. In agricultural fencing, for instance, wire fences are widely used.

[0004] For animal containment, wire fences and/or barbed wires are employed. Indeed, in order to prevent for example cows from leaning against the fencing or attempting from escaping over the fence, barbed wire can be employed for the whole fencing or as an additional element of a wire fence.

[0005] The need for barbed fencing has existed in fact in various domains, as can be seen from the vast prior art.

[0006] For example, US 715,541 and US 418,617 discloses wire fences erected with several line wires and provided with barbs extending in the fence plane from the wire lines, either upwardly or downwardly. Upwardly pointing barbs are not desirable for animal fencing, since they will only stick into the animal once above the fence.

[0007] Another approach that was proposed consists in modifying a welded wire mesh fence. For example, US 2,660,406 discloses welded wire mesh panels comprising barbs formed after a cutting and bending operation carried out on some of the welded wires. A similar solution is disclosed in US 2,271,314. This appears to be a cumbersome and costly manufacturing technique. Furthermore, for field fencing, woven or knotted wire fences are generally preferred to welded wire fences, because they can be more easily transported in rolls and are less expensive.

[0008] Today, a very popular type of field fence for animals is the wire fence with so-called hinge joints. Such steel wire fence consists of a plurality of line wires running parallel to the ground, the line wires being maintained spaced apart at regular intervals by lengths of wire referred to as stay wires. The stay wires extend generally perpendicularly to the wire lines and are united to the line wires at their ends intersecting with the line wires. That is, a stay wire extends between two adjacent line wires,

and is wrapped at each end around the line wire to form a hinge joint. Hinge joint fences are e.g. described in BS EN 10223-5:2012 "Steel wire and wire products for fencing and netting", part 5, from the British Standard Institution.

[0009] Hinge joint fences can absorb animal impact without damage and is the most economical joint choice available.

[0010] It must however be noticed that, in practice, one or two lines of barbed wire are generally fixed along the top line wire of a hinge joint wire fence, or installed within 10 to 50 cm inside the fencing, at about the same height. The barbed wire prevents cows from heavily leaning against the fence, or from attempting escaping, thereby helping in protecting the fence.

[0011] Hence, animal fencing, as carried out today remains a multi-step operation, where the hinge joint wire fence is first installed; and barbed wire is installed in a second step. Barbed wire manipulation remains burdensome, since great care is required to avoid operator injury. Furthermore, when the barbed wire is simply rolled around the top of the wire fence, it also protrudes on the external side of the fencing, causing a risk of injury for persons (strollers...) approaching too close.

[0012] US 561,193 and US 908,757 disclose barbed wire fences comprising a series of parallel wire strands connected by stay wires. Adjacent wire strands are connected by a series of stay wires arranged connecting the strands by being coiled at their end portions about the strands in such manner as to interlock the coils of the stay wires. Furthermore the terminal portions of the stay wires are pointed out to form laterally protruding barb at each intersection in the fencing.

35 OBJECT OF THE INVENTION (PROBLEM TO BE SOLVED)

[0013] The object of the present invention is to provide a simple fencing solution, adapted for animal fencing, that can be manufactured in a simple and cost effective process and that can be rapidly installed.

[0014] This object is achieved by a barbed wire fence as claimed in claim 1.

45 SUMMARY OF THE INVENTION

[0015] The present invention relates to a barbed wire fence of the type comprising a plurality of wires arranged in an intersecting manner to form a multiplicity of apertures, wherein intersecting wires are connected by joints formed by a joining wire portion. According to an important aspect of the invention, at least part of the joints are configured in such a way that a free end of the joining wire portion protrudes on one side of the fence, preferably substantially perpendicularly thereto, to form a barb end.

[0016] The present wire fence thus readily incorporates barbs that protrude laterally/on the side of the fence, i.e. they are not in the fence plane but turned to-

ward the animals enclosed in the fence. Therefore, the barb ends preferably all protrude on the same side of the fence.

[0017] It shall be appreciated that the barb ends (also referred to as spikes) are formed by a free end portion of a wire that is involved in a joint uniting two intersecting wires, which may then be referred to as barb joint. This approach is advantageous from the manufacturing point of view, since the barbs are obtained during the joint forming operation, by means of the wire that is normally used for connecting the intersecting wires together.

[0018] Contrary to prior art welded wire fences as e.g. known from US 2,660,406, it is not required to manufacture additional wire lines that will later be cut and bent.

[0019] Preferably, the joints are of the hinge type, where an end portion (forming the joining wire portion) of one of the intersecting wires is wrapped around the other wire. To form a barb hinge joint, the free end of the wrapped joining portion is left to protrude out of the fence plane.

[0020] A hinge joint wire fence in accordance with a preferred embodiment of the invention comprises a number of line wires spaced apart, preferably extending substantially parallel to one another, and two adjacent wire lines are united by transverse wires that are distributed along the wire lines, the ends of each of the transverse wires constituting the joining wire portions forming the joints around the respective line wires. Each joint is obtained by wrapping a transverse wire end portion around the respective intersecting wire line so as to form a hinge joint. In accordance with the invention, at least some of the hinge joints are thus realised as barb hinge joint having a free end of the joining wire portion protruding on one side of the fence.

[0021] As is clear to those skilled in the art, a hinge joint of an interior wire line is formed with end portions of two intersecting transverse wires coming from respective adjacent line wires. The two intersecting transverse wires may be wrapped in a helicoidal manner around the interior line wire, with one or more loops in common. Such joint may also be realised as barb joint, but generally using only one of the transverse wire free ends to form a protruding barb.

[0022] The barb joints may be arranged at any desirable wire intersection. In practice, it is interesting to arrange the barb joints in the upper region of the fence, e.g. along the top edge line wire (or along the two or three top line wires), to prevent animals from leaning on the fence. Barb joints may also be arranged in the bottom fence region, and/or along the bottom edge line wire (or 2 or 3 bottom line wires), to deter animals from attempting crawling under the fence.

[0023] In general, the protruding barbs at the barb joints extend preferably sensibly perpendicularly to the fence. Although an angle of about 90° is preferred, the barb ends may form an angle between 60° and 120° with the plane of the erected fence, or between 75° and 105°. The barb ends may protrude by at least 0.5 cm, 0.75 or

1 cm, preferably between 1 and 2 cm, from the fence plane.

[0024] For increased strength of the barb joints, the transverse wires involved in the latter (and having a barb-forming free end portion), in particular in the upper fence region, are made from steel having a comparatively greater tensile strength than that of the other transverse wires. This improves the stability and stiffness of the barbed sections, which will better resist load and therefore keep their deterrent function, while other sections may tend to bent under a heavy load by an animal.

[0025] It may be noted that although the present invention has been developed on the basis of a hinge joint wire fence, those skilled in the art may use the present inventive concept in other joint configurations, using a joining wire portion to unite intersecting wires. For example, in a knot mesh wire fence where intersecting line and stay wires are joined by a length of separate joining wire wound around the wire intersection to form a fixing knot, a free end of such joining wire may be left to protrude on the side of the fence to form a barb end.

[0026] According to another aspect, the present invention also relates to a process for manufacturing a wire fence comprising a plurality of wires arranged in an intersecting manner to form a multiplicity of apertures, wherein intersecting wires are connected by joints formed by a joining wire portion. The process is characterized in that at least part of the joints are formed by wrapping the joining wire portion at the wire intersection in such a way that a free end thereof protrudes on one side of the fence, preferably substantially perpendicularly thereto, to form a barb end.

[0027] To manufacture a hinge joint type wire fence, the plurality of wires includes a number of line wires (12) spaced apart, preferably extending substantially parallel to one another; the process comprising: uniting two adjacent wire lines by transverse wires (14) that are distributed along the wire lines, the ends of each transverse wires constituting said joining wire portion that are wrapped around the respective line wires to form hinge joints.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1: is a schematic diagram of a first embodiment of the present wire fence with hinged joints;

FIG. 2: shows enlarged views of a barb joint on the top line wire at detail A in Fig.1, namely a) as seen when facing the fence and b) from above the fence;

FIG. 3: is a schematic diagram of a second embodiment of the present wire fence;

FIG. 4: shows enlarged views of a barb joint on the 2nd wire line at detail C in Fig.4, namely a) as seen when facing the fence and b) from above the fence;

FIG. 5: shows enlarged views of a joint on intermediate line wire at detail D in Fig.1, namely a) as seen when facing the fence and b) from above the fence.

FIG. 6: a view of a conventional hinged joint in the top line wire of a hinge joint wire fence.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0029] A first embodiment of the present wire fence 10 is shown in Fig.1, where the joints are generally of the hinge type. The wire fence 10 comprises a plurality of parallel line wires 12_1 to 12_n that are maintained in a spaced apart relationship by transverse wires 14_1 to 14_n generally referred to as stay wires. The line wires 12_i -typically a relatively long single line wire- extend generally parallel to the ground and are therefore often horizontal. The transverse/stay wires 14_i are comparatively smaller lengths of wire (single strand) and extend transversally between two adjacent/neighbouring line wires 12_i and 12_{i+1} , often in a perpendicular manner (hence often vertically). Each stay wire 14_i is united at both extremities with a respective intersecting wire line 12_i , 12_{i+1} , in such a way as to form a joint. To form a hinge joint, an end portion of the stay wire, forming a joining wire portion, is wrapped (or coiled) around the line wire with which it intersects. The stay wires 14_i are distributed at periodic intervals along the line wires.

[0030] In the embodiment of Fig.1, the stay wires in two consecutive rows (i.e. stay wires 14_i and stay wires 14_{i+1}) are aligned and form a regular mesh pattern. It may be noted that different mesh pattern shapes can be envisaged, e.g. square or rectangular, and that the stay wires of two consecutive rows may be offset, forming a staggered stay wire configuration.

[0031] Classically, the stay wires 14_1 in the top row have their top joining end portion around the first/top line wire 12_1 (top selvedge line) and their bottom joining end portion around the second line wire 12_2 . In the case of aligned stay wires as shown in Fig. 2, the stay wires 14_2 of the second wire line 12_2 are aligned with those the stay wires 14_1 of the first row. Hence, stay wires 14_1 and 14_2 of the first and second rows intersect at a same location with the second line wire 12_2 . In such case, the joining ends of stay wires 14_1 and 14_2 are often jointly wrapped around the line wire.

[0032] It shall be appreciated that according to the present design, at least part of the stay wires have at least one of their end portions protruding on one (lateral) side of the fence 10 so as to form a barb end (or spike). Such joints are referred hereinafter also as barbed hinge joints.

[0033] In the embodiment of Fig.1, only the top line

wire 12_1 is provided with barb hinge joints, designated 16. Hence, the stay wires 14_1 of the first row form at their intersection with the first line 12_1 a joint that is obtained by wrapping the stay wire 14_1 in such a way as to form a free, terminal wire end protruding on one side of the fence, out from the fence plane. This is illustrated in detail in Figs. 2 and 3: the upper end portion of stay wire 14_1 (forming a joining wire portion) is wound around the top line wire 12_1 , typically making about two loops around the line wire 12_1 , and the upper free end of wire 14_1 is arranged to form a barb end 18 protruding on the side of the fence, i.e. generally perpendicularly to the fence plane.

[0034] The barb joint 16 of Fig. 2 can be compared with a conventional joint on a top line wire as shown in Fig. 6. In a conventional hinged joint, the stay wire 50 is normally wrapped around the line wire 52 by its joining portion 54 so that there is no protruding length of wire. As can be seen in Fig.6 b), the stay wire joining portion 54 is closely wrapped around the line wire, without protruding, and the wire 52 ends with a flat cut terminal end, here oriented upwardly.

[0035] The present fence 10 thus has its top line wire 12_1 featured with barb joints 16, the latter having laterally protruding barbs 18. Thanks to these integrated barb joints 16, the present fence can be readily installed for animal fencing, and does not require additional lines of barbed wire. Preferably, the barb ends 18 at the barb joints 16 protrude on the same side of the fence 10.

[0036] When the present fence is used for animal fencing near a road or walking path, the fence is of course oriented so that the barbs of the barb joints are turned inside the fence, towards the animals. The barbs will thus provide their deterrent effect against the animals, discouraging them from leaning against the fence. At the same time, since the barbs are turned on the same animal side, people walking along the fence no longer risk injuring themselves or tearing their clothes if they come too close.

[0037] Conventionally, the lower joint of the 1st row of stay wires 14_1 form a joint on the second line wire 12_2 , where they are, wrapped together with the joining end portion of the stay wires 14_2 from the second row. Hence, the lower end portions of the first row stay wires 14_1 form a conventional hinge joint, indicated 20, and the same is true for the other stay wires of the fence which form conventional hinged joints 20 at their intersections with line wires.

[0038] A joint 20 of conventional design, involving two stay wires intersecting a same line wire is shown in Fig. 8. The two wires are jointly wrapped, on the same side of the intersection.

[0039] Turning now to Fig. 4, there is shown a second embodiment of the present wire fence 10', where the first two line wires 12_1 and 12_2 of the fence are featured with barb joints. On the first line wire 12_1 , the barb joints 16 are formed in the same way as joints 16 in Figs.2.

[0040] On the second line, the barb joints, designated

16', here involve two stay wires 14_1 and 14_2 , and are wrapped around the line wire 12_2 in a conventional manner, however one of the stay wires 14_2 has a barb forming free end portion 18 that protrudes on one side of the fence. Turning to Fig.6, one can see that the upper and lower stay wires 14_1 and 14_2 , coming respectively from the 1st and 3rd line wires adjacent 2nd line wire 12_2 , are initially jointly wrapped in a conventional manner. However, the lower stay wire 14_2 has a longer joining portion, the free end of which is left to protrude perpendicularly to the fence so as to form a barb end 18. As for the barb-joints 16 of the first line, the protruding ends 18 have a sharp end.

[0041] In the example of Fig. 3 the joints at the lower intermediate line wires are conventional hinged joints 20 as shown in Fig.5.

[0042] As it will be clear to those skilled in the art, barb hinge joints 16 or 16' according to the present design, involving one or two stay wires, can be provided at any desired joint in the wire fence. In practice, in addition to the upper fence region, barb joints can be provided on the lower region, on the lower selvedge line 12_n and possibly on the neighbouring lines, which is beneficial to prevent animals from wiggling under the fence.

[0043] Conventionally, the wire used for the line and stay wires may generally be metallic wires, particularly steel preferably coated with a protective coating (typically galvanised).

[0044] The line wires 12 supporting the barb joints are preferably steel wires, advantageously coated with metallic (typically galvanised) and/or organic layers (typically with thermoplastic coatings for example polyvinyl chloride, polyethylene or paints for example polyester, polyurethane). Organic layers could provide an increase of the adherence between transverse and line wires by increasing the stick-slip effect (friction between both surfaces) or by compression. The wires are then securely anchored against both rotation and longitudinal movement. Organic layers can bring an additional colour allowing a better visualisation of the fence.

[0045] The transverse wires 14 having their joining end portion participating in barb joints 16 or 16' may advantageously consist of steel wires having a greater tensile strength than the other stay wires, in order to provide a stronger barbed fence, preferably a tensile strength of at least 700 N/mm².

[0046] For example, the transverse/stay wires that from regular joints 20 (i.e. do not form barb joints) may have a diameter in the range of 1.6 to 2.5 mm, in particular 1.9 to 2.0 mm; the tensile strength may be in the range of 400 to 600 N/mm².

[0047] The transverse wires 14 having their joining end portion(s) participating in barb joints 16 or 16' may consist of steel wires having similar diameter and a greater tensile strength, e.g. in the range of 700 to 900 N/mm².

[0048] The line wires may have a diameter in the range of 1.60 to 3.40 mm, in particular 1.90 mm to 2.40 mm. The top wire and/or bottom wire may have a larger

diameter than the other line wires. The tensile strength for line wires may vary between 700 and 1400 N/mm², in particular it may be in one of the following ranges: 700-900 N/mm², 1050-1200 N/mm², 1200-1400 N/mm².

[0049] The present wire fence may generally be manufactured to conform with above-mentioned standard BS EN 10223-5:2012, except for the barb joints 16, 16'.

[0050] It remains to be noted that the barb forming free ends 18 at the barb joints 16, 16' advantageously have a sharp end that may be obtained by performing a bias cut with a chisel, or other appropriate tool, instead of a straight perpendicular cut. The so obtained barb ends or spikes 18 may have a protruding length of at least 0.5 cm, e.g. 1 to 2 cm.

[0051] Although not shown in the drawings, the line wires 12_i may be evenly and regularly crimped between the stay wires 14_i to aid erection of the fence, which is further generally rolled upon manufacturing to facilitate storage and transport.

[0052] The above described hinge joint wire fence can be manufactured on a traditional hinge joint forming machine. The technical layout of the machine will however need to be partly adapted to allow forming and cutting each barb end, which is formed as an extension of the helicoidally/spirally wrapped wire portion of the respective hinge joint (installed on selected line wires of the fence).

[0053] Stay wire end portions will be wrapped around the line wire and cut at the over-length of min 5 mm, typically between 10 and 20 mm at an angle of e.g. 45-70° (relative to the wire axis) to create a sharp spike forming the barb end. Such barb end is preferably oriented in an angle of about 60 to 120°, preferably about 75 to 105°, more preferably about 90°, to the surface of the fence, creating a protective function. The orientation of the barb is realized by adjusting the twisting device in the machine.

[0054] For a safe transport through the machine, from the twisting device to the spooler where wire fence is rolled, several deviation rolls may be modified to avoid damaging the barb ends. In particular, the rolls can be provided with peripheral grooves to accommodate the barb ends.

[0055] The spooler may be modified as well to enable spooling without damaging the barb ends. And ensure safe take off of the finished roll.

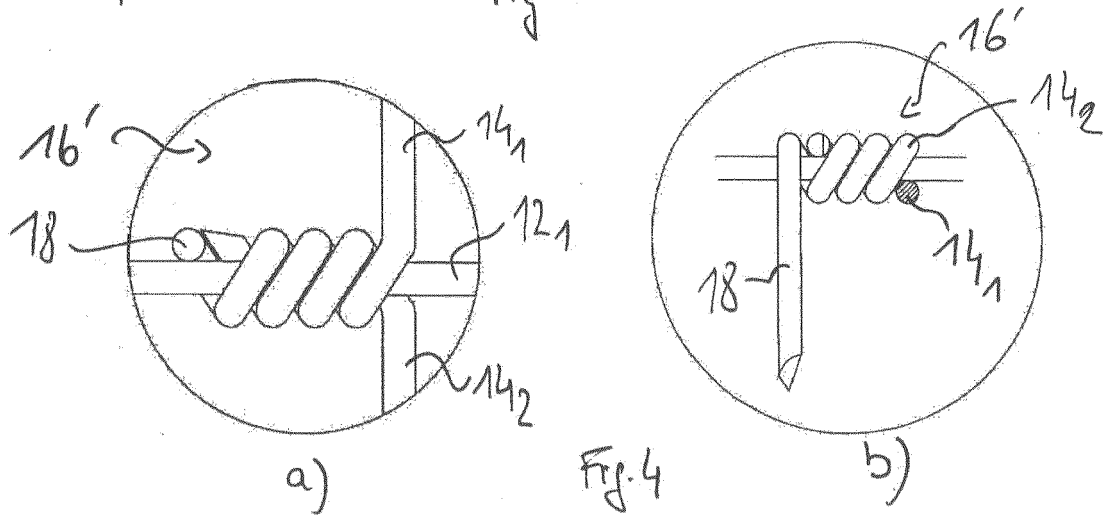
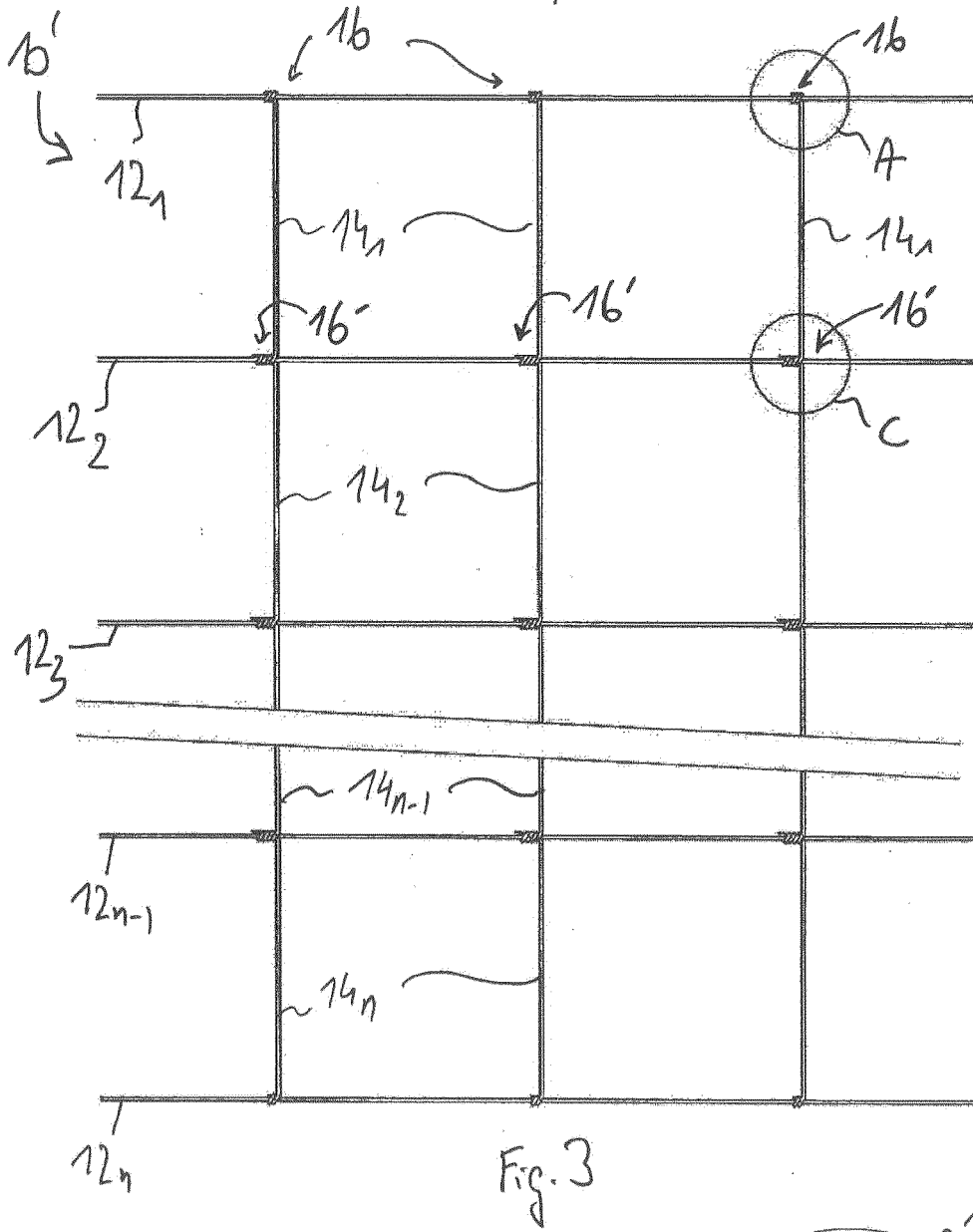
Claims

1. A wire fence comprising a plurality of wires (12, 14) arranged in an intersecting manner to form a multiplicity of apertures, wherein intersecting wires are connected by joints formed by a joining wire portion, wherein said plurality of wires includes a number of line wires (12) spaced apart, preferably extending substantially parallel to one another, and two adjacent wire lines are united by transverse wires (14) that are distributed along the wire lines, the ends of

- each of the transverse wires constituting joining wire portions forming said joints around the respective line wires; and at least part of said joints (16, 16') are configured in such a way that a free end (18) of said joining wire portion protrudes on one side of the fence, preferably substantially perpendicularly thereto, to form a barb end;
- characterized in that** the transverse wires (14₁; 14₂) forming the joints (16, 16') with protruding barb ends (18), in particular in the upper fence region, are made from steel having a comparatively greater tensile strength than that of the other transverse wires.
2. The wire fence according to claim 1, **characterized in that** said joints are hinge joints.
 3. The wire fence according to claim 1, wherein each of said joints are obtained by wrapping a transverse wire end portion around the respective intersecting wire line so as to form a hinge joint.
 4. The wire fence according to claim 3, wherein the hinge joint (20, 16') of an interior wire line (12_i) is formed with end portions of two intersecting transverse wires (14_{i-1}, 14_i) coming from respective adjacent line wires.
 5. The wire fence according to claim 4, wherein the hinge joint is formed by wrapping said two intersecting transverse wires (14₁, 14₂) in the same direction or in opposite directions along said interior line wire.
 6. The wire fence according to claim 4 or 5, wherein said two intersecting transverse wires (14₁, 14₂) are wrapped in a helicoidal manner around said interior line wire (14₂), with one or more loops in common.
 7. The wire fence according to any one of the preceding claims, wherein said joints with protruding barb ends are arranged in the upper region of the fence, preferably along the top line wire, or the two or three top line wires; and/or said joints with protruding barb ends are arranged in the upper region of the fence, in particular on the last or last two wire lines.
 8. The wire fence according to any one of the preceding claims, wherein said protruding barb ends (18) form an angle in the range of 60 to 120° with the fence plane, preferably about 75 to 105°, more preferably about 90°.
 9. The wire fence according to any one of the preceding claims, wherein said barb ends (18) protrude by at least 0.5 cm, preferably between 1 and 2 cm, from the fence plane.
 10. The wire fence according to any one of the preceding claims, wherein said barb ends (18) protrude on the same side of the wire fence.
 11. The wire fence according to any one of the preceding claims, wherein said barb ends (18) have a sharp end point.
 12. The wire fence according to any one of the preceding claims, wherein the line wires in the upper fence region, intersecting with the transverse wires forming the joints with protruding barb ends, are provided with an adherence increasing and/or coloured coating.
 13. The wire fence according to any one of the preceding claims, wherein said line wires consist of a single wire strand; and/or said transverse wires consist of a single wire strand, the latter extending preferably perpendicularly to the line wires.
 14. The wire fence according to any of the preceding claims, wherein said wire fence can be rolled, in particular for storage/transport purposes.
 15. A process for manufacturing a wire fence comprising a plurality of wires arranged in an intersecting manner to form a multiplicity of apertures, wherein intersecting wires are connected by joints formed by a joining wire portion, wherein said plurality of wires includes a number of line wires (12) spaced apart, preferably extending substantially parallel to one another;

the process comprising: uniting two adjacent wire lines by transverse wires (14) that are distributed along the wire lines, the ends of each transverse wires constituting said joining wire portion that are wrapped around the respective line wires to form hinge joints;

wherein at least part of said joints (16, 16') are formed by wrapping said joining wire portion at the wire intersection in such a way that a free end (18) thereof protrudes on one side of the fence, preferably substantially perpendicularly thereto, to form a barb end; **characterized in that** the transverse wires (14₁; 14₂) forming the joints (16, 16') with protruding barb ends (18), in particular in the upper fence region, are made from steel having a comparatively greater tensile strength than that of the other transverse wires.



PRIOR ART

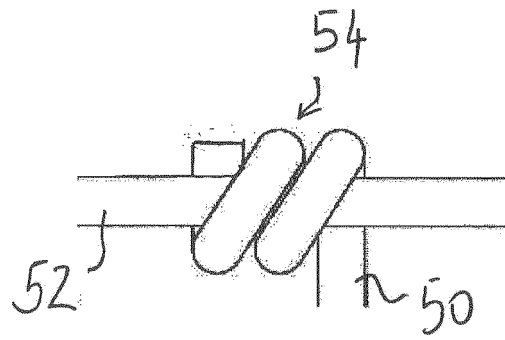


Fig. 6

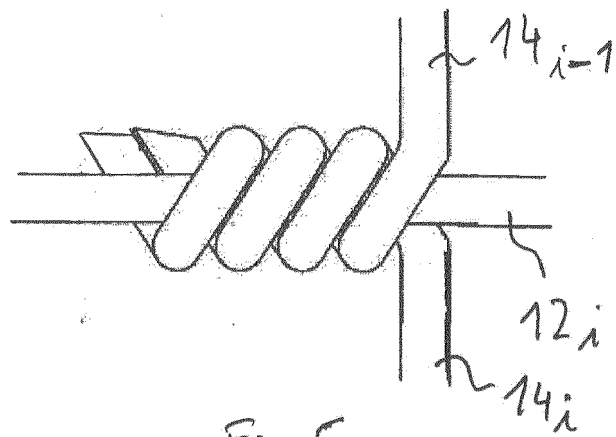


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 16 17 5726

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 561 193 A (BATES) 2 June 1896 (1896-06-02) * page 1, lines 55-70; figures 2-6 *	1-15	INV. E04H17/04 B21F27/02
A	US 908 757 A (DILLON PAUL W [US] ET AL) 5 January 1909 (1909-01-05) * page 1, lines 53-66; figures 1-4 *	1-15	
A	US 285 979 A (DODGE) 2 October 1883 (1883-10-02) * claim 1; figures 1-5 *	1-15	
A	US 1 434 051 A (ELLIOTT JOHN L ET AL) 31 October 1922 (1922-10-31) * claim 1; figures 1,2 *	7	
A	US 238 255 A (SHUMAN) 1 March 1881 (1881-03-01) * figure 1 *	10	
A	GB 1 602 292 A (TINSLEY WIRE LTD) 11 November 1981 (1981-11-11) * claim 1; figures 1,2 *	12	TECHNICAL FIELDS SEARCHED (IPC) E04H B21F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 25 October 2016	Examiner Rosborough, John
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/02 (P04/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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25-10-2016

	Patent document cited in search report	Publication date	Patent family member(s)	Publication date
	US 561193 A	02-06-1896	NONE	
	US 908757 A	05-01-1909	NONE	
15	US 285979 A	02-10-1883	NONE	
	US 1434051 A	31-10-1922	NONE	
	US 238255 A	01-03-1881	NONE	
20	GB 1602292 A	11-11-1981	NONE	
25				
30				
35				
40				
45				
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 715541 A [0006]
- US 418617 A [0006]
- US 2660406 A [0007] [0018]
- US 2271314 A [0007]
- US 561193 A [0012]
- US 908757 A [0012]