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(12) (19) (CA) **Demande-Application**

(21) (A1) **2,288,258**
(86) 1998/04/21
(87) 1998/10/29

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(51) Int.Cl.[6] A61F 13/00, A61F 13/02
(30) 1997/04/22 (9708078.2) GB

(54) **BANDAGE**

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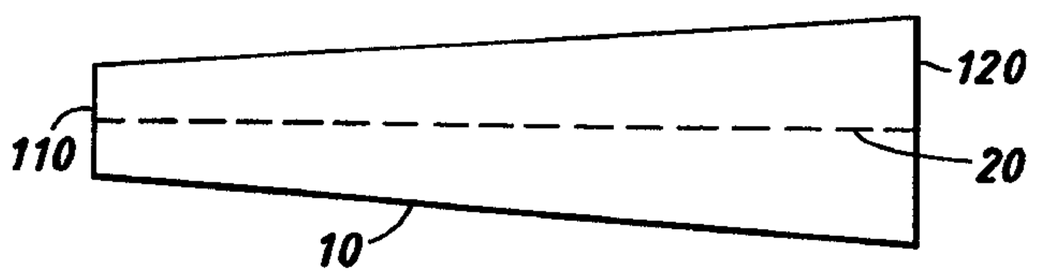

(57) L'invention porte sur un bandage compressif qui comprend une bande de matériau élastique, longitudinale, comportant des première et seconde extrémités et pourvue d'une ligne de guidage s'étendant de la première à la seconde extrémité. La caractéristique de cette bande est que la ligne de guidage n'est pas parallèle à au moins un de ses bords. La largeur de la première extrémité peut être plus étroite que celle de la seconde extrémité, ou bien la bande peut avoir des côtés parallèles à la ligne de guidage qui s'étend généralement en diagonale sur sa longueur.

(57) A compression bandage is provided comprising a longitudinal, substantially elasticated strip of material having first and second ends and provided with a guideline extending from said first end to said second end, characterised in that the general disposition of the guideline is non-parallel with respect to at least one of the edges of the strip. The width of said first end may be narrower than that of said second end or strip may have parallel sides with the guideline extending generally diagonally along its length.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : **A61F 13/00, 13/02** | **A1**

(11) International Publication Number: **WO 98/47452**

(43) International Publication Date: 29 October 1998 (29.10.98)

(21) International Application Number: PCT/GB98/01159

(22) International Filing Date: 21 April 1998 (21.04.98)

(30) Priority Data:
9708078.2 22 April 1997 (22.04.97) GB

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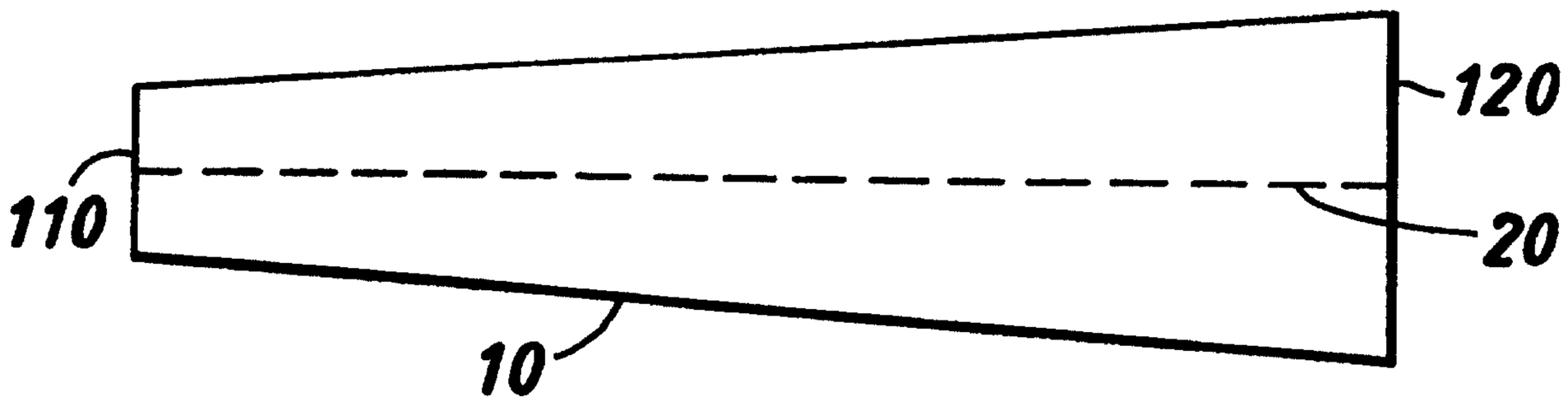
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: BANDAGE



(57) Abstract

A compression bandage is provided comprising a longitudinal, substantially elasticated strip of material having first and second ends and provided with a guideline extending from said first end to said second end, characterised in that the general disposition of the guideline is non–parallel with respect to at least one of the edges of the strip. The width of said first end may be narrower than that of said second end or strip may have parallel sides with the guideline extending generally diagonally along its length.

BANDAGE

The present invention relates to a compression bandage for application to a body portion.

Woven or knitted elastic bandages in both adhesive and non-adhesive forms are used to provide support and to assist in the repair of soft tissues such as the healing of strained muscles and in the treatment of various venous conditions.

It is important that these bandages are applied at a tension which is sufficiently high to enable them to maintain an effective level of compressive force under the bandage over a period of time.

Conventionally bandages are provided with a central guideline to allow the bandage to be applied with a 50% overlap, thus providing two layers. These rely on the tapered shape of a limb to provide graduated compression. For example if a bandage is applied with a constant force and a 50% overlap to the lower leg a higher compressive force is provided at the ankle which is the narrower end.

The use of a constant force allows a consistent extension of the compression bandage, resulting in graduated compression on application to a tapered limb.

Various features are employed by manufacturers of compression bandages to achieve consistent extension when such a bandage is applied to a limb.

These include marking compression bandages with rectangles which on reaching the desired extension are viewed as squares.

Such a bandage is disclosed in WO96/31175 wherein the extensible article comprises an indicator that is interlaced with the extensible bandage in order to show when the bandage has reached a predetermined degree of extension.

Compression bandages are normally specified according to the Laplace equation;

AMENDED SHEET

$$P = \frac{471nFs}{Wc}$$

where P = pressure (mmHg)
n = number of layers
F = force in bandage (N)
s = stress relaxation factor
W = bandage width (cm)
c = limb circumference (cm)

n = 2 for a 50% overlap
= 5 for a 80% overlap
s : assumed to be 0.75
F : assumed to be 10N

Thus the theoretical amount of compression provided can be calculated.

For example for a standard shaped limb, such as a lower leg with an ankle circumference of 23cm and a calf circumference of 35cm the theoretical compression that can be provided with a conventional compression bandage of width 10cm, applied with a 50% overlap is 30.7mmHg of pressure at the ankle and 20.2mmHg at the calf.

However as is the case with many patients, limb shape is not standard and in extreme cases the calf circumference may be the same as that of the ankle. In such instances graduated compression could only be achieved by applying the bandage with more force at the ankle which would certainly be far from consistent and accurate.

Current desired levels of pressure within the medical profession are 40mmHg at the ankle and 18mmHg at the calf.

Therefore the present invention seeks to avoid the disadvantages of the prior art where the amount of graduated

compression provided is determined by, inter alia, the shape of the limb, as currently compression bandages are designed to be applied with a constant force by the provision of markings that reach a particular identifiable configuration when the bandage has been stretched to a desired degree.

Accordingly the present invention provides a compression bandage comprising a longitudinal, substantially elasticated strip of material having first and second ends and provided with a guideline extending from said first end to said second end, characterised in that the general disposition of the guideline is non-parallel with respect to at least one of the edges of the strip.

Substantially elasticated materials may comprise elastic and non-elastic filaments and include any materials well known to those skilled in the art of making compression bandages.

The compression bandage of the invention is constructed such said bandage is applied with constant extension to a uniform cylinder said first end is adapted to give a first compression and said second end is adapted to give a second, lower compression such that the ratio of pressure exerted upon the cylinder by said second end to the pressure exerted by said first end is less than 1.

This can be achieved by several means such as the use of tapered bandages comprising a narrow first end and a wider second end where the narrow first end is applied to the end of the limb where a higher pressure exertion is required, for example the ankle and thus the wider second end is applied to the end of the limb such as the calf where a lower pressure exertion is required.

In an embodiment of the present invention there is provided a compression bandage, as hereinbefore described, capable of providing a graduated compression to a limb wherein the bandage is tapered.

Preferably the degree of tapering is 50% from the wider second end to the narrow first end.

Most preferably the degree of tapering is 30% from the wider second end to the narrow first end.

The guide line of such tapered bandages be disposed along the central line of the strip such that it is equi-distant from both edges at any given point but not parallel to either edge. Alternatively, the guideline may be disposed such that it is parallel to only edge of the strip forming the bandage.

Another means for achieving a similar effect would be to provide a diagonal guideline along a compression bandage where the compression bandage has a constant width. The guideline is present to achieve the desired amount of overlap. To achieve a higher pressure exertion more overlap is required. To achieve an even, graduated compression the overlap should be at least 50%. Thus although the edges of the strip are parallel with respect to each other, the guideline is not parallel to either edge

In an aspect of this embodiment of the present invention there is provided a compression bandage as hereinbefore described wherein the bandage is of a constant width and is provided with a diagonal guidelines such that disposition of the diagonal guideline should provides at least a 50% overlap on application.

If less than a 50% overlap is provided the pressure profile would be inappropriate for the therapeutic effect of compression treatment.

The guideline may be straight, curved lines or may be stepped or staggered line..

In yet another embodiment of the present invention there is provided a compression bandage as hereinbefore described which is provided with markings to assist achieving a desired degree of extension. For example it is known to provide compression bandages having a line of markings, each mark being rectangular in an unstretched state and appearing as a square when the bandage is stretched to a desired degree. Other markings include loops of thread or material, lettering or other shapes. Such markings may be varied along the length of the bandage to provide a predetermined varied degree of extension.

Compression bandages are also available which provide consistent compression independently of bandage extension within a working range as described in Patent application No.WO90/00297. Such bandages usually comprise an elastomeric copolymer, eg. a triblock copolymer such as styrene-butadiene-styrene or styrene-ethylene-butylene-styrene and a non-elastomeric yarn. Thus there is also provided a compression bandage as hereinbefore described wherein the bandage provides consistent compression independently of bandage extension.

According to the present invention there is provided the use of a compression bandage as hereinbefore described for compression therapy.

The compression bandage of the present invention provides graduated compression on a uniform cylindrically shaped limb and would provide reinforced graduated compression on a normal tapered leg and would therefore allow even higher gradients to be easily achieved.

There is also provided a process for making compression bandages as hereinbefore described such as knitting a tapered bandage with the same number of elastic warp threads all the way along, preparing a non-woven tapered or constant width bandage with elastic filaments stuck on lengthwise while the bandage is in an extended form, or a woven bandage using methods known to those skilled in the art.

The guideline on a constant width or tapered compression bandage, as hereinbefore described, may be provided by incorporating a coloured thread during the bandage making process or may be sewn or drawn on afterwards. For a constant width bandage the guideline is preferably diagonal for the length of the bandage and should provide at least a 50% overlap. For a tapered bandage the guideline is preferably a central guideline along the length of the bandage.

In some cases of lower leg compression treatment it may be desirable to wrap some of the bandage around the foot of the patient to provide extra stability and retaining of the bandage. The use of conventional compression bandages unless applied very loosely would result in increased pressure on the foot and heel which may cut off blood circulation to the extremities such as the toes with devastating consequences.

Therefore according to the present invention there is also provided a bandage capable of providing graduated compression with a low pressure exerting section, at the first end.

This may be provided by having a constant width starting section at the first end at least as wide or wider than the narrow first section and/or fewer elastic filaments at the first end.

The present invention will now be described by way of example only with reference to the accompanying tables and drawings.

Example 1

Tables 1 to 4 show the theoretical compression calculated using the Lapace equation as hereinbefore described, achieved using a compression bandage on a tapered limb with an ankle circumference of 23cm. The bandages illustrated are a conventional bandage with an initial and final width of 10cm (Table 1), and tapered bandages of the present invention ranging from an initial

width of 7.5cm and a final width of 10cm (Table 2) to an initial width of 2.5cm and a final width of 10cm (Table 4).

Example 2

Tables 5-8 shows the theoretical compression achieved using the same compression bandages as described above on a non-tapered, cylindrical leg with an ankle and calf circumference of 35cm.

Thus it is clearly illustrated that the use of a conventional compression bandage with a constant width and a central guideline relies on the degree of tapering of the limb or varying the force applied to provide graduated compression, whereas the compression bandage of the present invention with a central guideline will apply graduated compression to any limb without having to vary the force used to apply the compression bandage.

Table 1

Ankle Circumference (cm)	23	Initial Bandage Width (cm)	10
Calf Circumference (cm)	35	Final Bandage Width (cm)	10

Counter	Interval Up Lower Limb	Limb Circumfer-ence (cm)	Bandage Length (cm)	Bandage Width (cm)	Pressure (mmHg)
1	0	23	0	10	30.7
2	3.5	24.2	23.6	10	29.2
3	7	25.4	48.4	10	27.8
4	10.5	26.6	74.4	10	26.6
5	14	27.8	101.6	10	25.4
6	17.5	29	130	10	24.4
7	21	30.2	159.6	10	23.4
8	24.5	31.4	190.4	10	22.5
9	28	32.6	222.4	10	21.7
10	31.5	33.8	255.6	10	20.9
11	35	35	290	10	20.2

Table 2

Ankle Circumference (cm)	23	Initial Bandage Width (cm)	5
Calf Circumference (cm)	35	Final Bandage Width (cm)	10

Counter	Interval Up Lower Limb	Limb Circumfer-ence (cm)	Bandage Length (cm)	Bandage Width (cm)	Pressure (mmHg)
1	0	23	0	5	61.4
2	3.5	24.2	23.6	5.5	53.1
3	7	25.4	48.4	6	46.4
4	10.5	26.6	74.4	6.5	40.9
5	14	27.8	101.6	7	36.3
6	17.5	29	130	7.5	32.5
7	21	30.2	159.6	8	29.2
8	24.5	31.4	190.4	8.5	26.5
9	28	32.6	222.4	9	24.1
10	31.5	33.8	255.6	9.5	22.0
11	35	35	290	10	20.2

Table 3

Ankle Circumference (cm)	23	Initial Bandage Width (cm)	7.5
Calf Circumference (cm)	35	Final Bandage Width (cm)	10

Counter	Interval Up Lower Limb	Limb Circumfer-ence (cm)	Bandage Length (cm)	Bandage Width (cm)	Pressure (mmHg)
1	0	23	0	7.5	41.8
2	3.5	24.2	23.6	7.75	37.7
3	7	25.4	48.4	8	34.8
4	10.5	26.6	74.4	8.25	32.2
5	14	27.8	101.6	8.5	29.9
6	17.5	29	130	8.75	27.8
7	21	30.2	159.6	9	26.0
8	24.5	31.4	190.4	9.25	24.3
9	28	32.6	222.4	9.5	22.8
10	31.5	33.8	255.6	9.75	21.4
11	35	35	290	10	20.2

Table 4

Ankle Circumference (cm)	23	Initial Bandage Width (cm)	2.5
Calf Circumference (cm)	35	Final Bandage Width (cm)	10

Counter	Interval Up Lower Limb	Limb Circumfer-ence (cm)	Bandage Length (cm)	Bandage Width (cm)	Pressure (mmHg)
1	0	23	0	2.5	122.9
2	3.5	24.2	23.6	3.25	89.8
3	7	25.4	48.4	4	69.5
4	10.5	26.6	74.4	4.75	55.9
5	14	27.8	101.6	5.5	46.2
6	17.5	29	130	6.25	39.0
7	21	30.2	159.6	7	33.4
8	24.5	31.4	190.4	7.75	29.1
9	28	32.6	222.4	8.5	25.5
10	31.5	33.8	255.6	9.25	22.5
11	35	35	290	10	20.2

Table 5

Ankle Circumference (cm)	35	Initial Bandage Width (cm)	10
Calf Circumference (cm)	35	Final Bandage Width (cm)	10

Counter	Interval Up Lower Limb	Limb Circumfer-ence (cm)	Bandage Length (cm)	Bandage Width (cm)	Pressure (mmHg)
1	0	35	0	10	20.2
2	3.5	35	35	10	20.2
3	7	35	70	10	20.2
4	10.5	35	105	10	20.2
5	14	35	140	10	20.2
6	17.5	35	175	10	20.2
7	21	35	210	10	20.2
8	24.5	35	245	10	20.2
9	28	35	280	10	20.2
10	31.5	35	215	10	20.2
11	35	35	350	10	20.2

Table 6

Ankle Circumference (cm)	35	Initial Bandage Width (cm)	5
Calf Circumference (cm)	35	Final Bandage Width (cm)	10

Counter	Interval Up Lower Limb	Limb Circumfer-ence (cm)	Bandage Length (cm)	Bandage Width (cm)	Pressure (mmHg)
1	0	35	0	5	40.4
2	3.5	35	35	5.5	36.7
3	7	35	70	6	33.6
4	10.5	35	105	6.5	31.1
5	14	35	140	7	28.8
6	17.5	35	175	7.5	26.9
7	31	35	210	8	25.2
8	24.5	35	245	8.5	23.7
9	28	35	280	9	22.4
10	31.5	35	315	9.5	21.2
11	35	35	350	10	20.2

Table 7

Ankle Circumference (cm)	35	Initial Bandage Width (cm)	7.5
Calf Circumference (cm)	35	Final Bandage Width (cm)	10

Counter	Interval Up Lower Limb	Limb Circumfer-ence (cm)	Bandage Length (cm)	Bandage Width (cm)	Pressure (mmHg)
1	0	35	0	7.5	26.9
2	3.5	35	35	7.75	26.0
3	7	35	70	8	25.2
4	10.5	35	105	8.25	24.5
5	14	35	140	8.5	23.7
6	17.5	35	175	8.75	23.1
7	21	35	210	9	22.4
8	24.5	35	245	9.25	21.8
9	28	35	280	9.5	21.2
10	31.5	35	315	9.75	20.7
11	35	35	350	10	20.2

Table 8

Ankle Circumference (cm)	35	Initial Bandage Width (cm)	2.5
Calf Circumference (cm)	35	Final Bandage Width (cm)	10

Counter	Interval Up Lower Limb	Limb Circumfer-ence (cm)	Bandage Length (cm)	Bandage Width (cm)	Pressure (mmHg)
1	0	35	0	2.5	80.7
2	3.5	35	35	3.25	62.1
3	7	35	70	4	50.5
4	10.5	35	105	4.75	42.5
5	14	35	140	5.5	36.7
6	17.5	35	175	6.25	32.3
7	21	35	210	7	28.8
8	24.5	35	245	7.75	26.1
9	28	35	280	8.5	23.7
10	31.5	35	315	9.25	21.8
11	35	35	350	10	20.2

Figures 1 and 2 are of a tapered compression bandage, and Figures 3 and 4 are of a conventional compression bandage with a diagonal guideline.

Figures 5 and 6 are lower leg limbs such as are conventionally treated using compression therapy.

Figure 1 schematically shows a tapered compression bandage (10) with a central guideline (20), a narrow first end (110) and a wider second end (120).

Figure 2 schematically shows a tapered compression bandage (10) with a central guideline (20) and a lower pressure exerting section (30).

Figure 3 schematically shows a compression bandage with a constant width (40) and a diagonal guideline (50) which does not go past the midpoint (55).

Figure 4 schematically shows a compression bandage with a constant width (40) and a diagonal guideline where the diagonal guideline is curved (60), which does not go past the midpoint (55).

Figure 5 schematically shows a lower limb (70) where the ankle (80) circumference is narrower than the calf (90) circumference.

Figure 6 schematically shows a lower limb (100) where the ankle (80) circumference is equal to the calf (90) circumference.

The effect of a tapered compression bandage (10) with a guideline (20) [Figure 1] on a limb (70, 100) can be illustrated by the following calculations.

Assuming the narrow edge (110) of tapered bandage (10) is 5cm wide, the wider edge (120) is 10cm wide, the force applied is 10N, overlap is 50% (n=2), stress relaxation is 0.75 and the limb

(70) circumference is 23cm at the ankle (80) and 35cm at the calf (90) then the pressure applied is as follows:

$$P(mmHg)_{\text{at ankle}} = \frac{471 \times 2 \times 10 \times 0.75}{23 \times 5} = 61.4mmHg$$

$$P(mmHg)_{\text{at calf}} = \frac{471 \times 2 \times 10 \times 0.75}{35 \times 10} = 20.2mmHg$$

If the limb (100) circumference is 23cm at the ankle (80) and 23cm at the calf (130), the pressure applied with the tapered compression bandage is as follows:

$$P(mmHg)_{\text{at ankle}} = \frac{471 \times 2 \times 10 \times 0.75}{23 \times 5} = 61.4mmHg$$

$$P(mmHg)_{\text{at calf}} = \frac{471 \times 2 \times 10 \times 0.75}{23 \times 10} = 30.7mmHg$$

In contrast the use of a compression bandage with constant width (10cm) and a central guideline providing 50% overlap (n=2) and all other factors being equal, the pressure applied to limb (70) where the ankle circumference is 25cm and the calf circumference is as follows:

$$P(mmHg)_{\text{at ankle}} = \frac{471 \times 2 \times 10 \times 0.75}{23 \times 10} = 30.7 \text{ mm Hg}$$

14

$$P(mmHg) = \frac{471 \times 2 \times 10 \times 0.75}{35 \times 10} \quad \text{at calf}$$

$$= 20.2 \text{ mm Hg}$$

For limb (100) where both the ankle and calf circumference are 23cm the pressure would be as follows:

$$P(mmHg) = \frac{471 \times 2 \times 10 \times 0.75}{23 \times 10} \quad \text{at ankle}$$

$$= 30.7 \text{ mm Hg}$$

$$P(mmHg) = \frac{471 \times 2 \times 10 \times 0.75}{23 \times 10} \quad \text{at calf}$$

$$= 30.7 \text{ mm Hg}$$

Thus it is clearly illustrated that the use of a tapered compression bandage can be used to provide graduated compression on limb shapes ranging from uniformly cylindrical to tapered.

CLAIMS

1 A compression bandage (10) comprising a longitudinal, substantially elasticated strip of material having first and second ends and provided with a guideline (20) extending from said first end (110) to said second end (120), characterised in that the general disposition of the guideline (20) is non-parallel with respect to at least one of the edges of the strip.

2 A bandage (10) as claimed in claim 1 wherein the bandage is tapered, the width of said first end (110) is narrower than that of said second end (120).

3 A bandage (10) as claimed in claim 2 wherein the degree of tapering is 50% from the wider second end to the narrow first end (110).

4 A bandage (10) as claimed in any of the preceding claims wherein the guideline (20) is disposed along the central line of the strip and is non-parallel with respect to either edge of the strip.

5 A bandage (10) as claimed in any of the preceding claims wherein the guideline is disposed parallel with respect to one edge of the strip.

6 A bandage (10) as claimed in claim 1 wherein the edges of the strip are parallel with respect to each other, said guideline being parallel to neither edge

7 A bandage (10) as claimed in claim 6 wherein the diagonal guideline is disposed on the strip to provide at least a 50% overlap on application.

8 A bandage (10) as claimed in any one of the preceding claims wherein the guideline is a straight, curved or stepped line extending from said first to said second ends.

FIG. 1.

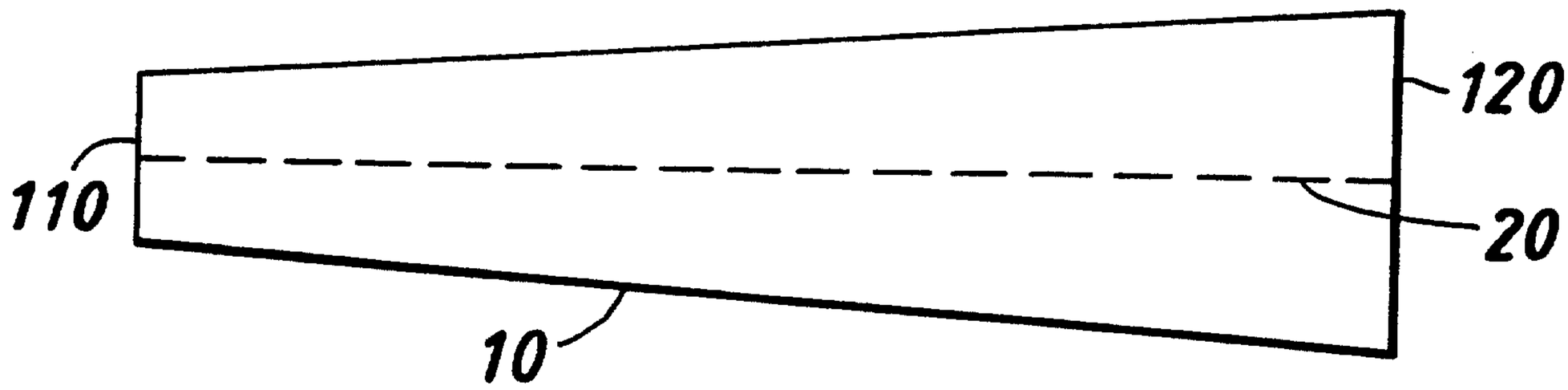


FIG. 2.

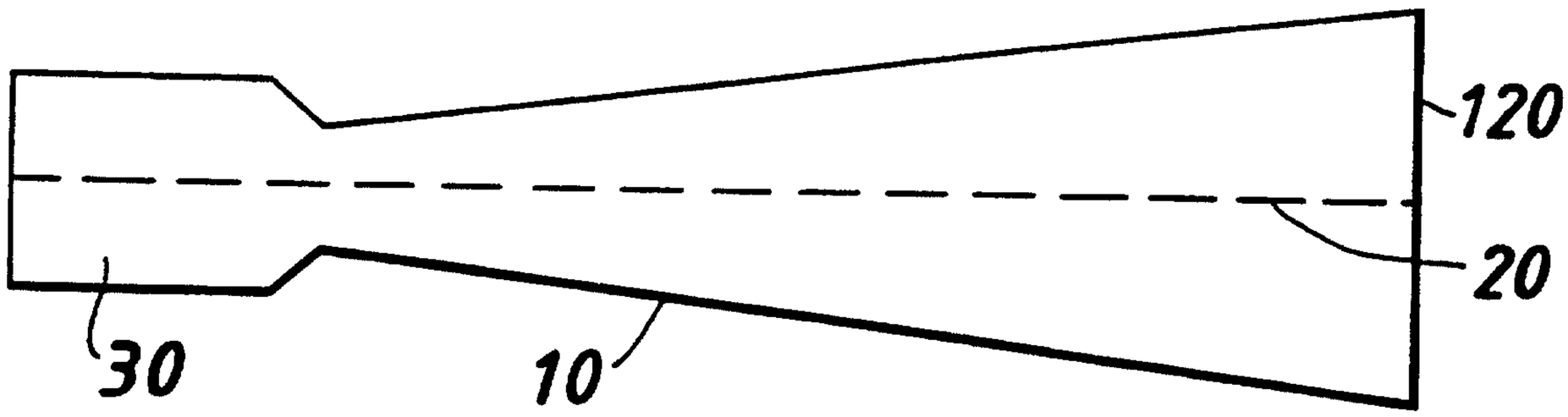


FIG. 3.

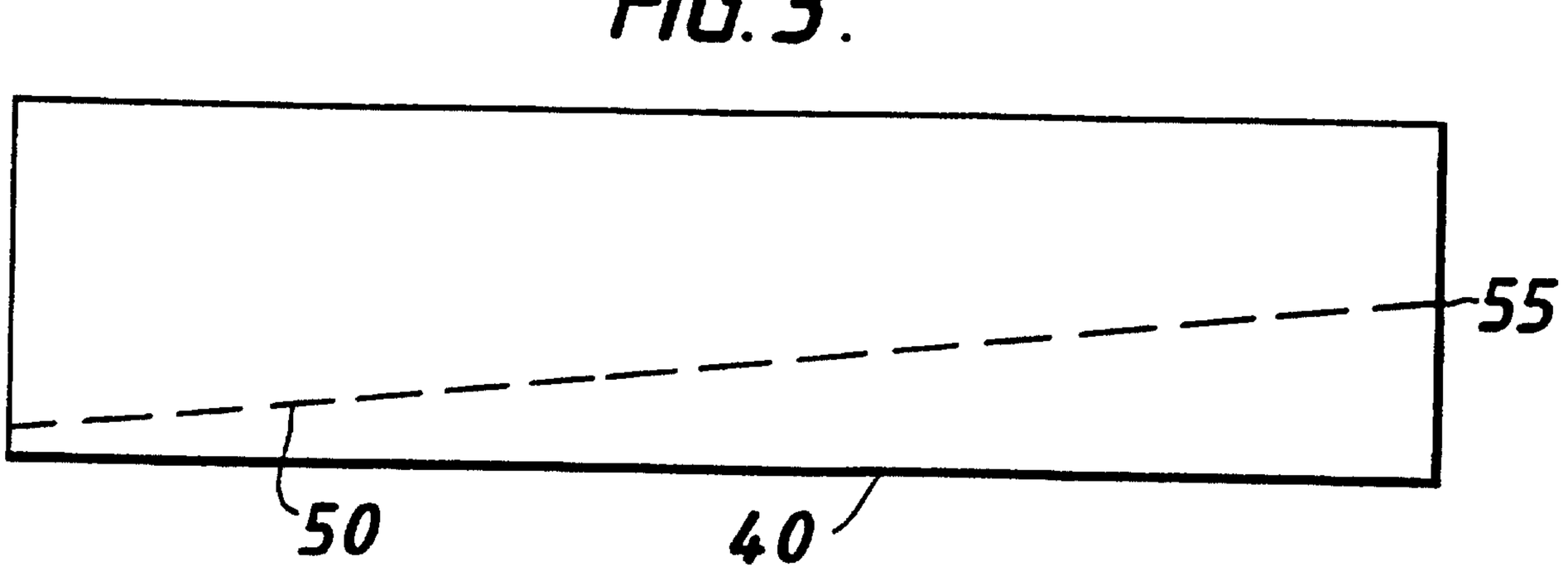


FIG. 4.

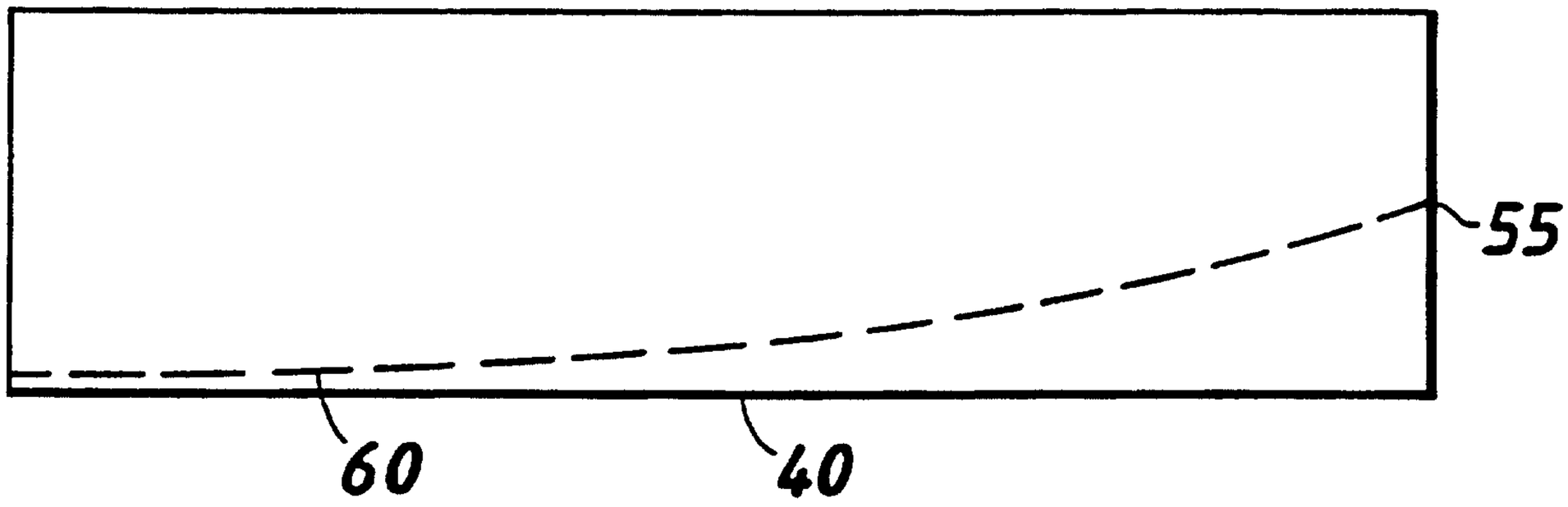


FIG. 5.

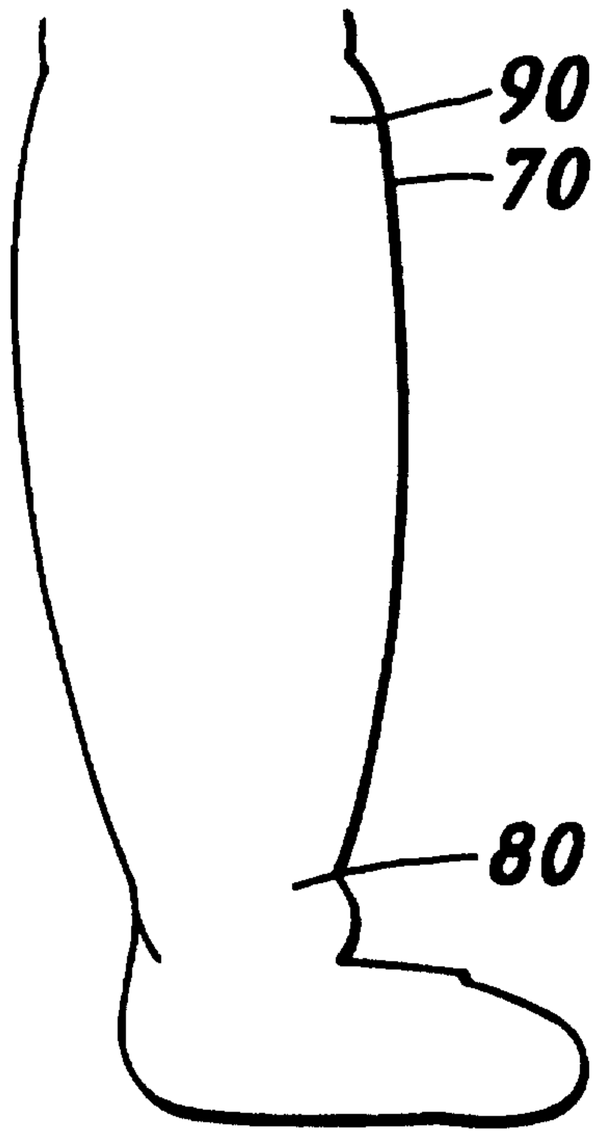


FIG. 6.