



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.07.2021 Bulletin 2021/29

(51) Int Cl.:
B65H 75/14 (2006.01) B65H 75/30 (2006.01)

(21) Application number: **20152346.1**

(22) Date of filing: **17.01.2020**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA ME
KH MA MD TN**

• **DE PAUW, Stijn**
9041 Oostakker (BE)
• **DESLOOVERE, Johan**
8792 Desselgem (BE)

(71) Applicant: **NV Bekaert SA**
8550 Zwevegem (BE)

(74) Representative: **Seynhaeve, Geert Filiep**
NV Bekaert SA
IPD - PC6030
Bekaertstraat 2
8550 Zwevegem (BE)

(72) Inventors:
• **VERKENS, Bram**
1501 Buizingen (BE)

(54) **METAL SPOOL**

(57) The invention relates to a metal spool (100) for use in the tire industry as carrier for steel tire cord. More in particular the spool (100) is suited for use on a tire cord creel provided with magnetic spool holders. The spool (100) is designed to carry steel monofilaments that are currently being pursued for reinforcement of the belt layer of a tire. The spool (100) comprises a larger than standard core (104) to which two flanges (102, 102') are welded. At least the flanges (102, 102') are made of ferromagnetic

metal sheet that is thicker than the metal sheet used in prior art spools and this for reasons of strength. The flanges (102, 102') The flanges have an annular attraction zone (110) for contacting the magnet spool holder. The flanges (102, 102') are provided with a magnetic reduction means to reduce magnetic attraction by the magnet spool holder. The magnetic attraction reduction means can be implemented in different ways as exemplified in the different embodiments of the invention.

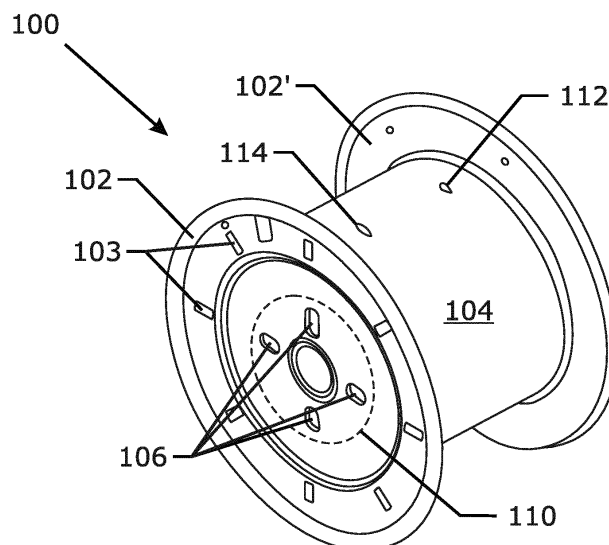


Fig. 1

Description

Technical Field

[0001] The invention relates to a metal spool for use with a magnetic spool holder as present on creels for unwinding arrays of spools. Such creels are particularly used in rubber sheathing installations for making tires. The metal spool is suitable for winding steel wire, in particular steel cord or even more preferred steel monofilament.

Background Art

[0002] When making tires the soft rubber material must be reinforced with strong and flexible tire cords. Tire cords are either made of organic fibres or from steel, the latter being generally referred to as steel cords. For the purpose of this application a steel cord consists of one single filament called monofilament or from an assembly of different filaments called multi-filament steel cords.

[0003] These steel cords are encased in parallel between rubber sheets by unwinding them from a multitude of spools mounted on a pay-off creel. Between 150 and 1500 spools are unwound in one single operation from a creel. The spools are mounted and demounted from the creel in an automatic, semi-automatic or manual operation possibly supported by lifting equipment to reduce human effort. The industry standard spool within the tire industry is called BS40 and BS60 (for net weights up to 40 pounds) or BS80 (for weights up to 80 pounds). An example is shown in USD504806S. Literally millions of BS spools are circulating between tire factories and steel cord plants.

[0004] Recently there is renewed interest to replace the traditionally used multi-filament steel cord with one single steel monofilament for use in the reinforcement of the belt of the tire. The use of monofilaments offers certain advantages to the tire in that a single filament offers the highest breaking load over cross sectional area. Also the bending stiffness is the highest possible within the same cross sectional area. In general a monofilament of between 0.30 to 0.40 mm in combination with an increased tensile strength of 'super tensile' level ('ST' a tensile strength larger than 3400 MPa on a 0.35 mm filament) or 'ultra tensile' level ('UT' a tensile strength larger than 3700 MPa on a 0.35 mm filament) is capable of replacing currently popular multi-filament steel cords such as 2x0.25, 2x0.30, 2+2x0.22, 3x0.25 or similar constructions. For the tire the use of a monofilament brings advantages in terms of reduced rolling resistance and reduced tire weight.

[0005] However, the use of monofilaments also brings particular processing problems with it at the steel cord producer as well as at the tire maker's end. The winding of the thick, stiff and less extensible monofilaments compared to traditional multi-filament cords on the regular BS40, BS60 and BS80 spools results in increased wind-

ing pressure on the core as well as an increased opening force on the flanges of the spool. This to the extent that the lifetime of the spools greatly reduces as the welds between core and flange crack, the flanges deform unacceptably after limited use and even cores may collapse under the increased pressure. Also the presence of the ribs in the flanges of the known BS40 and BS80 results in the filament getting caught between windings and flanges resulting in tension spikes and bent wires during unwinding of the monofilament.

[0006] Although the skilled person may quickly think of thicker metal sheet, for both flanges and core for overcoming these strength problems this results in another problem in that - due to the increased plate thickness of the flanges - the magnetic attraction between the spool flange and the magnet of the pay-off spindle of the creel increases too much such that empty spools are difficult to remove from the creel. Indeed every spindle of a creel is provided with an annular permanent magnet at the foot of the spindle that keeps the spool on the spindle without the need of securing the spindle at the cantilever end by means of a pin or lock. An early example of magnetic holding is disclosed in US 3396919

[0007] The inventors thus looked for solutions as described hereinafter.

Disclosure of Invention

[0008] It is an object of the invention to offer a spool that is particularly suitable for delivering steel monofilament to a tire producer. The spool offers an increased strength while remaining acceptable in weight. The spool is - in empty state - easy to remove from the magnetic holder on a creel. Furthermore it offers an increased life cycle, an improved unwinding capability and a better straightness upon unreeling.

[0009] According a first aspect of the invention a spool as per the features of claim 1 is described. The spool is intended for use with a magnetic spool holder. The spool comprises a core of cylindrical shape and two flanges that are welded to the ends of the core. At least the flanges are made of ferromagnetic metal sheet. The flanges are provided with a bore hole for insertion of the spindle of the creel. Usually, a tube coaxial to the core connects the bore holes of both flanges to ease mounting of the spool on the spindle but this is not essential to the invention. Around the bore there is an annular attraction zone centred at the bore hole. This attraction zone will be attracted by the magnet of the magnetic spool holder when the spool is mounted on the magnet spindle.

[0010] The magnet of the spindles itself is provided in a circular housing. The magnet is mounted flush with or preferably slightly below the rim of the housing. When the magnet is situated slightly below the rim of the housing a gap forms between the magnet and the spool flange, while the spool flange rests on the rim of the housing. This to prevent damage to the magnet and/or to reduce the magnetic attraction of the magnet holder. This gap

is fixed and cannot easily be adjusted. The current creels provided with magnet holders are therefore specifically adapted to the current standardised BS40, BS60 and BS80 spools.

[0011] Magnet spindles of creel installations are thus standardised parts of which the outer diameter of the magnet housing have an outer diameter of 75 to 110 mm, for example 100 mm. The spindle itself has a diameter of between 30 to 35 mm for example 32.5 mm or of between 15 to 19 mm for example 17 mm. Hence the attraction zone extends from the outer edge of the bore hole to just a few millimetre outside where the rim of the magnet housing touches the flange. The attraction zone thus extends to a circle with radius of between 35 and 60 mm, for example 55 mm co-centred to the bore hole.

[0012] As the steel cord on the spool must be unwound from the creel with a constant pay-off tension, the spool must not rotate freely on the spindle. The magnetic spool holder is braked in a controlled way to adjust the tension of unwinding of the steel cord. The magnetic attraction should therefore generate enough friction that the spool does not rotate freely on the spindle.

[0013] Not all steel cord creels use magnetic spool holders. For those installations that do not have magnetic spool holders one or more drive holes need to be provided in the spool flange zone for engagement of a drive pin present on the spool holder. The presence of the drive holes is optional as installations with magnetic spool holders work without drive pins.

[0014] With 'ferromagnetic metal sheet' is meant any metal sheet that can be attracted by a magnet. Most preferred are steel sheets that contain sufficient iron in order to be attracted. Typical steel sheets are according EN 10149-2 'Hot rolled steels for cold forming'. The thickness and the yield strength of the ferromagnetic metal sheet is important because it determines the strength of the spool. As such the thickness of the steel sheet of prior art spool flanges is 1.2 mm with a yield strength of less than 280 MPa. This is one of the reasons why the prior art spools are not sufficiently strong to hold monofilament steel cord.

[0015] The ferromagnetic metal sheet of the flanges of the metal spool according the invention must therefore have a thickness of above 1.2 mm and below 3.0 mm, more preferably between 1.5 mm and 2.0 mm or best between 1.5 mm and 1.8 mm and/or in combination with a yield strength that is larger than 280 MPa, more preferably larger than 300 MPa, e.g. larger than 320 MPa. Yield strength is measured according ISO 6892-1(2019).

[0016] On the other hand the thickness of the metal sheet influences the magnetic attraction force: using thicker ferromagnetic metal sheet results in a higher attraction force making it difficult to pull the spool from the spindle which is a problem for the creel operator. The force needed to pull an empty spool from the magnetic spool holder should remain between 150 and 200 newton. Higher forces are too demanding to the operator, lower forces may lead to slippage of the spool.

[0017] Another method by which the strength of the flanges can be improved is by providing them with multiple debossed areas of plastically compressed metal sheet. The debossed areas extend radially outward of the core at the outer side of the flanges. Care should be taken that the material is compressed - and not deformed - as this would lead to a deformed inner side of the flange that on its turn could lead to winding problems. This is a fifth preferred embodiment.

[0018] What is now particular about the spool is that a magnetic reduction means is provided in the attraction zone. The purpose of this magnetic reduction means is to reduce the magnetic attraction of the magnetic spool holder. The magnetic reduction means reduces the force that is needed to pull the spool - be it empty or full - from the spindle. The presence of a magnetic reduction means on the spool eliminates the need to adjust the magnetic attraction force on the magnetic spool holder. Prior art spools as well as the inventive spools can thus be used interchangeably on the same creel.

[0019] According a first preferred embodiment the magnetic reduction means can be a non-magnetic layer that is present in at least part of the attraction zone. More preferred the non-magnetic layer is present in an annular zone that contacts the rim of the housing of the magnet of the magnet holder.

[0020] The non-magnetic layer can be provided in the form of a - possibly self-adhesive - polymer disk with a copy of the bore hole and optional drive holes' position. In practice the inventors find that at least a distance between the magnet and the flange of between 1.0 and 2.0 mm is necessary in order to abate the magnetic attraction of the spools sufficiently on currently used creels. Therefore more preferred is if the thickness of the polymer disk is between 0.1 and 0.5 mm, for example 0.3 mm.

[0021] An alternative way to implement a non-magnetic layer in at least the attraction zone is to provide the polymer layer as a non-magnetic paint. This is the easiest to implement as it can be applied during the production of the spool and does not need additional production and mounting of a polymer disc. Preferably the thickness of the layer is at least 0.1 mm and at most 0.5 mm, or even more preferred between 0.1 and 0.4 mm, or even between 0.2 and 0.3 mm. These paint thicknesses are much higher than the normally applied electrostatically applied paints on prior art spools.

[0022] If the thickness of the non-magnetic layer is too thin, the magnetic attraction will remain too high. If the magnetic layer is too thick, the magnetic attraction will be too low that may lead to slip of the spool on the magnet holder.

[0023] In a second preferred embodiment, the magnetic reduction means takes the form of one, two or more depressions in the attraction zone. With 'depressions' is meant an indentation of the metal sheet within the attraction zone that is lower than the edge, the outer border of the attraction zone. The axial height of the outer edge or border of the attraction zone is the level of the attraction

zone. The depressions must be at least 0.5 mm below the level of the attraction zone. Then the surface area of the one, two or more depressions is at least 30% to 100% of the total area of the attraction zone. If the depressions are 1.0 mm below the level of the attraction zone, the surface of the one, two or more depressions can be smaller, for example between 20 to 80% of the total area of the attraction zone.

[0024] If the total surface of the depressions is too small the magnetic reduction will not be sufficient. If the total surface is too high, the metal spool will release too easily and - even worse - may start to slip on the magnetic holder.

[0025] In the case of only one area - the depression can be a single closed area centred around the bore hole. In any case the radially outer limit of the depression must still be within the attraction zone. In a single closed area around the bore hole the metal sheet is sunken compared to the level of the attraction zone. For ease of implementation the one closed area can be an annular area centred around the bore hole.

[0026] According a third preferred embodiment the magnetic reduction means is in the form of two, three or more protrusions, bumps, ridges in the attraction zone. The protrusions are preferable deformed in the metal sheet of the flange. The protrusions contact the magnet and ensure a sufficient distance between the magnet and the attraction zone. The height of the three or more protrusions relative to the level of the attraction zone is between 1.1 mm and 2.0 mm, or even between 1.1 and 1.5 mm. The axial height of the outer border of the attraction zone is the level of the attraction zone. The area of the protrusions should be sufficiently small for instance smaller than the area of the optional drive hole in order not to have increased attraction to the magnet by the contacting protrusions. The protrusion can for example be a round raising, a height in the metal sheet with a diameter of 10 mm or less. This embodiment has the advantage that it is independent of the magnet to rim distance.

[0027] Alternatively the protrusions can be two, three, four, five up to twenty four, elongated, radially elongated ridges extending just over the attraction zone. The ridges contact the rim of the metal housing of the magnetic spindle and thereby ensure sufficient distance between magnet and spool flange. In this embodiment, the ridges should extend between 0.1 and 1.0 mm, or even between 0.2 and 0.5 mm or even more preferred between 0.2 and 0.4 mm above the level of the surrounding attraction zone.

[0028] According a fourth preferred embodiment the magnetic reduction means takes the form of additional holes or openings that are made in the attraction zone. Indeed, by removing magnetic material in the attraction zone, the magnetic attraction is diminished. Advantageously the attraction diminishes linear with the amount of material removed. In order to have sufficient effect at least 10% to 40% of the total area of the attraction zone

must be removed. In the amount of area removed, the surface area of the optional one or more drive holes are included. Care should be taken that the additional openings do not interfere with the drive holes i.e. could be mistaken for drive holes. Also there is a limit to the amount of material that can be removed as this also jeopardizes the strength of the spool. The inventors estimate that at least 50% of the material must remain.

[0029] According a fifth preferred embodiment, the metal core of the spool has an outer core diameter 'Do' and the flanges have a flange diameter 'Df'. The difference (Df-Do) must be less than half of the flange diameter, even more preferred is if it is less than one third of the flange diameter. Phrased differently: the ratio (Df-Do)/Df is less than 50% or less than 40%, or even less than 35%. This reduces the volume on the spool that can be used for winding wire relative to the total volume of the spool to less than 75% or less than 64% or even less than 55%. Hence, the useful volume is reduced in the inventive spool compared to conventional spools that have a volume usage of more than 75%, even more than 88%.

[0030] Monofilaments have a diameter that is larger than the filament diameters in conventional multi-filament steel cords. As a consequence the monofilaments - when wound on a conventional spool that typically has a core diameter of 117 mm - tend to adapt to the smaller core diameter of the conventional spool. The longer the monofilament remains on the spool (weeks, months), the more outspoken this 'relaxation' phenomenon comes. When the monofilament is then unwound from the conventional spool the monofilament has an arced aspect with a too small radius of curvature. The problem aggravates when the monofilament nears the core of the spool i.e. near the end of the spool. As a consequence the monofilament is difficult to arrange in parallel into a rubber ply as the wire tends to tip over and torque. The inventors therefore traded in useful volume for winding wire for a larger core diameter to abate the relaxation phenomenon while remaining within the limitations of existing creel installations.

[0031] The flange size Df is typically set to between 300 mm to 250 mm, or between 280 and 250 mm, 255 mm being the standard.

[0032] According a sixth preferred embodiment the core of the spool is provided with a steel wire retention hole for holding the end of the steel wire at the start of the winding. Conventional steel wire retention holes are circular. By using a retention hole in the shape of a lens curve or the shape of a teardrop curve or any curve having one or two V-shaped ends that are oriented circumferentially to the core, the steel wire is held better at the start of the winding. Conversely when the wire is unwound, the end is slightly held before it drops out of the retention hole.

[0033] According a second aspect of the invention a metal spool whereon steel monofilament is wound is presented. The monofilament has a diameter 'd' that is typ-

ically between 0.25 and 0.50 mm, for example between 0.299 and 0.351 mm. The metal spool is the metal spool as presented before in according any one of the different embodiments on its own or taken in combination. The ratio of the outer core diameter D_o and monofilament diameter D_o/d is larger than 400, or even larger than 430.

Brief Description of Figures in the Drawings

[0034]

Figure 1 is a drawing of the generic form of the inventive spool.

Figure 2a and 2b is a drawing of a first embodiment of the invention, Figure 2a being the section along line AA' of Figure 2b;

Figure 3a and 3b is a drawing of a second embodiment of the invention, Figure 3a being the section along line BB' of Figure 3b;

Figure 4a and 4b is a drawing of a third embodiment of the invention, Figure 4a being the section along line CC' of Figure 4b;

Figure 5a and 5b is a drawing of a fourth embodiment of the invention, Figure 5a being the section along line DD' of Figure 5b.

[0035] In the figures the tens and unit digits of the reference numbers refer to identical items - if present - across drawings. The hundred digit refers to the drawing number.

Mode(s) for Carrying Out the Invention

[0036] Figure 1 shows the inventive spool 100 in its most generic form. The spool consists of a core 104 and two flanges 102, 102' welded to the core. The spool has a central bore hole of 33 mm, suitable for use on a steel cord creel.

[0037] The outer flange diameter D_f is 255 mm and the core outer core diameter D_o is 173 mm. Hence $(D_f - D_o)/D_f$ is 32% or the core diameter is about two thirds of the flange diameter: see Figure 2a. So only 54% of the volume internal to the cylinder capped by the spool flanges can be filled with wire. In prior art spools the core diameter is smaller than half of the flange diameter (117 mm vs 255 mm) and useable volume of the spool is 79 % of the volume internal to the spool flanges.

[0038] The advantages of such design are that:

- When the spool is completely filled with monofilament the flanges are less stressed than in the prior art spools;
- The relaxation phenomenon is less in that the monofilament wire will take an arc shape when unwound from the spool with a much larger radius than when wound on prior art spools.

[0039] The flanges 102, 102' are made of a ferromag-

netic material notably S355MC according EN10149-2 with a yield strength of about 355 MPa. The flanges have a thickness of 1.7 mm which is much thicker than the current art spools having a thickness of 1.2 mm. As a result the flanges resist better the bending under the pressure of the monofilament compared to the prior art spools. However, due to the increased presence of magnetic mass - the sheet metal - the pull-off force needed to pull an empty spool from the magnetic spindle reaches 250 N, exceeding the 200 N which is the currently acceptable maximum force.

[0040] The spool flange is attracted by the magnetic spindle in the annular attraction zone indicated by 110. In order to overcome the excessive magnetic attraction a magnetic reduction means is provided in the attraction zone 110 to reduce the attraction by the magnet. Although the magnetic spool holder may comprise the possibility to reduce attraction (for example by mounting the magnet deeper into its housing), it is far more easier for the user to mount spools adapted to be used on the current creel setting than to have to adjust the hundreds of magnetic spool holders on the creel.

[0041] The spool is also provided with four drive holes 106 to enable the spools also to be used on a steel cord creel using non-magnetic spool holders that use a drive pin to immobilise the spool relative to the spool holder. Rectangular embossings 103 further increase the bending resistance of the flanges. At those embossings the metal sheet is locally compressed. Care needs to be taken that the embossing does not reach through the flange: the inside of the flange must remain flat and smooth at all times. Retention holes for the monofilament that end in a V-shape such as a 'lens shape' 114 or even a 'tear-drop shape' 112 are provided in the core of the spool. The ending in a 'V'-shape helps to retain the smooth and slippery monofilament.

[0042] A first way to provide a magnetic attraction reduction means is to provide a non-magnetic layer 220 in at least part of the attraction zone 210 (see Figure 2). The non-magnetic layer is present as an annular painted layer at the border of the attraction zone. The non-magnetic layer must position between the rim of the housing of the magnet of the magnetic spool holder and the spool flange. By various tests the inventors found that a layer thickness of 150 μm gave sufficient reduction in magnetic attraction.

[0043] Figures 4a and 4b show a second way to provide a magnetic attraction reduction means in the form of four elongated protrusions or ridges 440, 440', 440'', 440''' that are radially oriented and extend axially outwardly from the attraction zone as shown in section CC' of Figure 4a. In this embodiment the ridges provide a gap between the flange and the rim of the housing of the magnet of the magnetic spool holder and thereby reduce the magnet attraction to the bulk of the flange. The ridges 440, 440', 440'', 440''' only extend 200 μm above the level of the attraction zone that is the axial position of the border of the attraction zone excluding the ridges. The

surface of the ridges is kept minimal for example 4 mm wide and 20 mm long.

[0044] An alternative - depicted in Figures 3a, 3b - and opposite way to the previous embodiment of providing a magnetic attraction reduction means is to increase the distance between the bulk of the attraction zone and the magnet by retracting the flange body relative to the level at the border of the attraction zone. In the embodiment of Figure 3 this has been realised by providing depressions 330, 330', 330", 330''' in the attraction zone. These depressions cover an area of 25 % of the total attraction zone and reach 750 μ m below the level of the outer border of the attraction zone as shown in section BB' of Figure 3a.

[0045] By taking the embodiment of Figures 3a, 3b to the extreme, one arrives at the example of Figure 5. There parts 550, 550', 550", 550''' of the flange material in the attraction zone have been removed and this in addition to the drive holes 506 already present. In total - i.e. including the cut out area of the drive holes - a surface of 25 % out of the attraction zone 510 has been removed.

Claims

1. A metal spool for use with a magnetic spool holder, said metal spool comprising a core and two flanges welded at either end of said core, at least said flanges being made of a ferromagnetic metal sheet, said flanges have a bore hole for receiving a spindle and an annular attraction zone centred at the bore hole for contacting said magnetic spool holder, said attraction zone optionally being provided with one or more drive holes,
characterised in that
a magnetic attraction reduction means is provided in said attraction zone to reduce the magnetic attraction of the magnetic spool holder.
2. The metal spool according to claim 1 wherein said magnetic attraction reduction means is a non-magnetic layer in at least a part of said attraction zone.
3. The metal spool according to claim 2 wherein said non-magnetic layer is a polymer layer with a thickness of at least 0.1 mm and at most 0.5 mm.
4. The metal spool according to claim 1 wherein said magnetic attraction reduction means is two, three or more protrusions extending axially outwardly from said attraction zone.
5. The metal spool according to claim 4 wherein said two, three or more protrusions extend between 1.1 mm and 2.0 mm axially above the outer border of said attraction zone.
6. The metal spool according to claim 4 wherein said

two, three or more protrusions are radially elongated ridges extending over the border of the attraction zone, said elongated ridges rising 0.1 mm to 1.0 mm above the level of the attraction zone.

7. The metal spool according to claim 1 wherein said magnetic attraction reduction means is one, two or more depressions in said attraction zone.
8. The metal spool according to claim 7 wherein said one, two or more depressions reach at least 0.5 mm axially below the outer border of said attraction zone and wherein the surface area of said one, two or more depressions is at least 20% of the total area of said attraction zone.
9. The metal spool according to claim 7 or 8 wherein one depression is present in a closed area centred around said bore hole with rim of the depression being still within the attraction zone.
10. The metal spool according to claim 1 wherein said magnetic attraction reduction means are openings in said attraction zone, wherein the total area of said openings together with the openings of said optional one or more drive holes is at least 10% of the total area of said attraction zone.
11. The metal spool according to any one of the preceding claims wherein the thickness of said ferromagnetic metal sheet of said flanges is at least 1.2 mm and not more than 3.0 mm.
12. The metal spool according to claim 11 wherein the yield strength of said ferromagnetic metal sheet of said flanges is at least 280 MPa.
13. The metal spool according to any one of the preceding claims wherein said core has an outer core diameter 'Do' and said flanges have a flange diameter 'Df' wherein the ratio (Df-Do)/Df is less than 50 per cent.
14. The metal spool according to any one the preceding claims wherein said core is provided with a steel wire retention hole, said steel wire retention hole having the shape of a lens curve or the shape of a teardrop curve or any curve having one or two V-shaped ends that is oriented circumferentially to the core.
15. A metal spool containing steel monofilament, said monofilament having a diameter 'd', said metal spool being according any one of claims 1 to 14 wherein the core of said metal spool has an outer core diameter 'Do' **characterised in that** the ratio 'Do/d' is larger than 400.

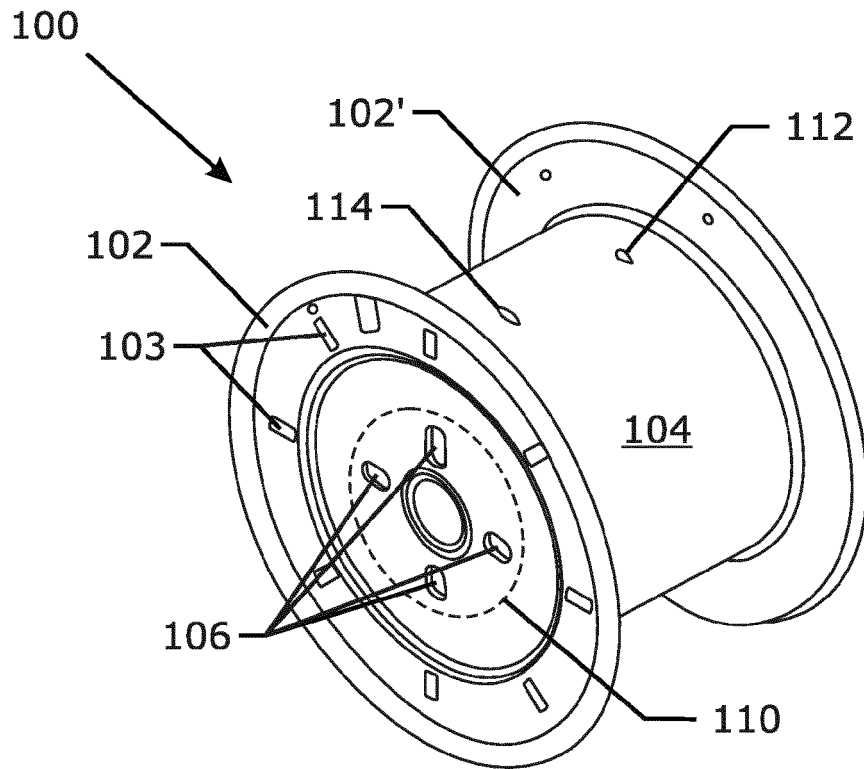


Fig. 1

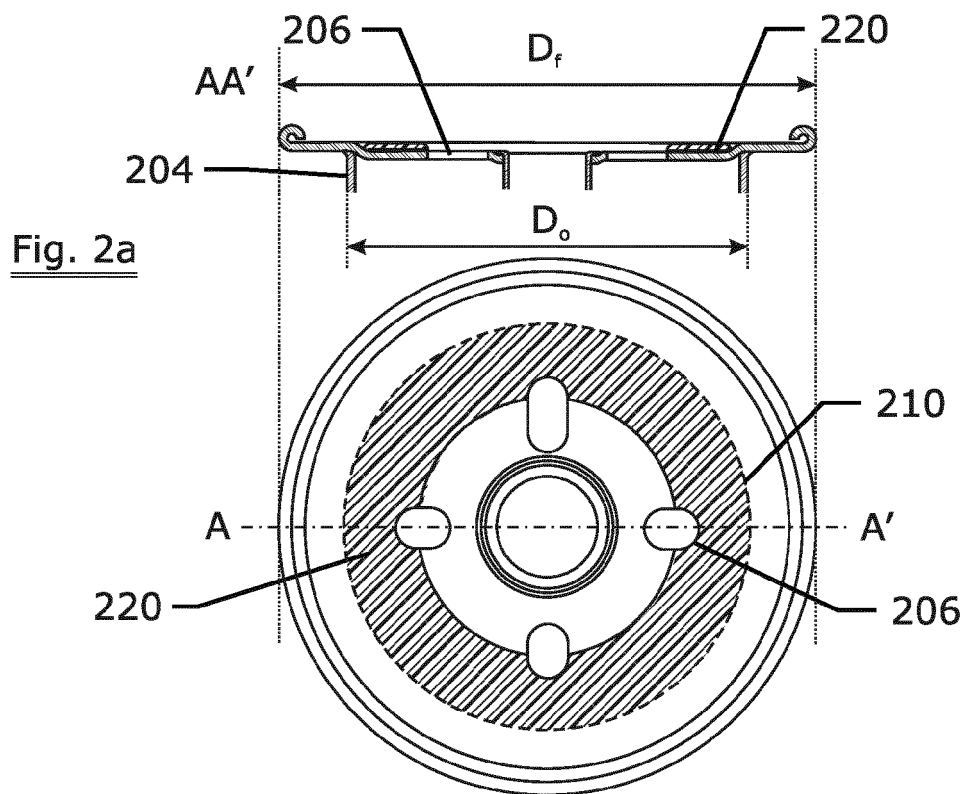


Fig. 2a

Fig. 2b

Fig. 2

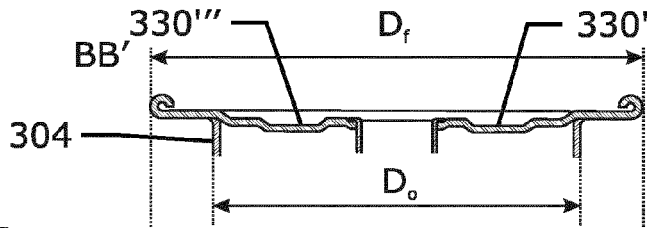


Fig. 3a

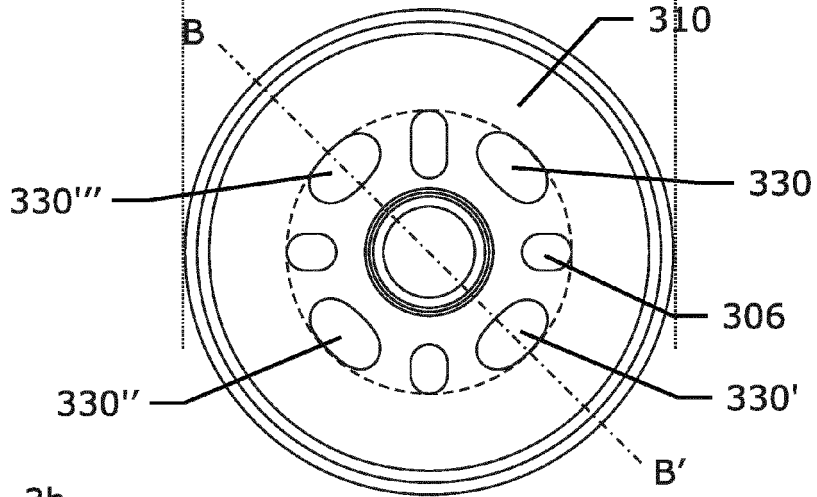


Fig. 3b

Fig. 3

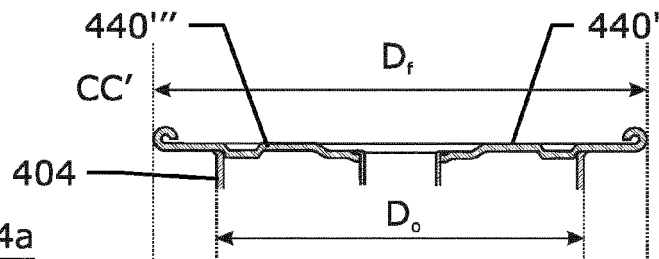


Fig. 4a

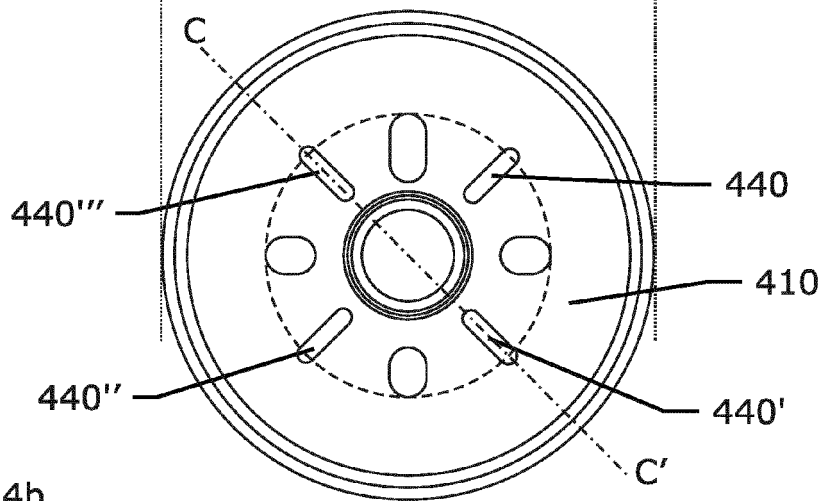


Fig. 4b

Fig. 4



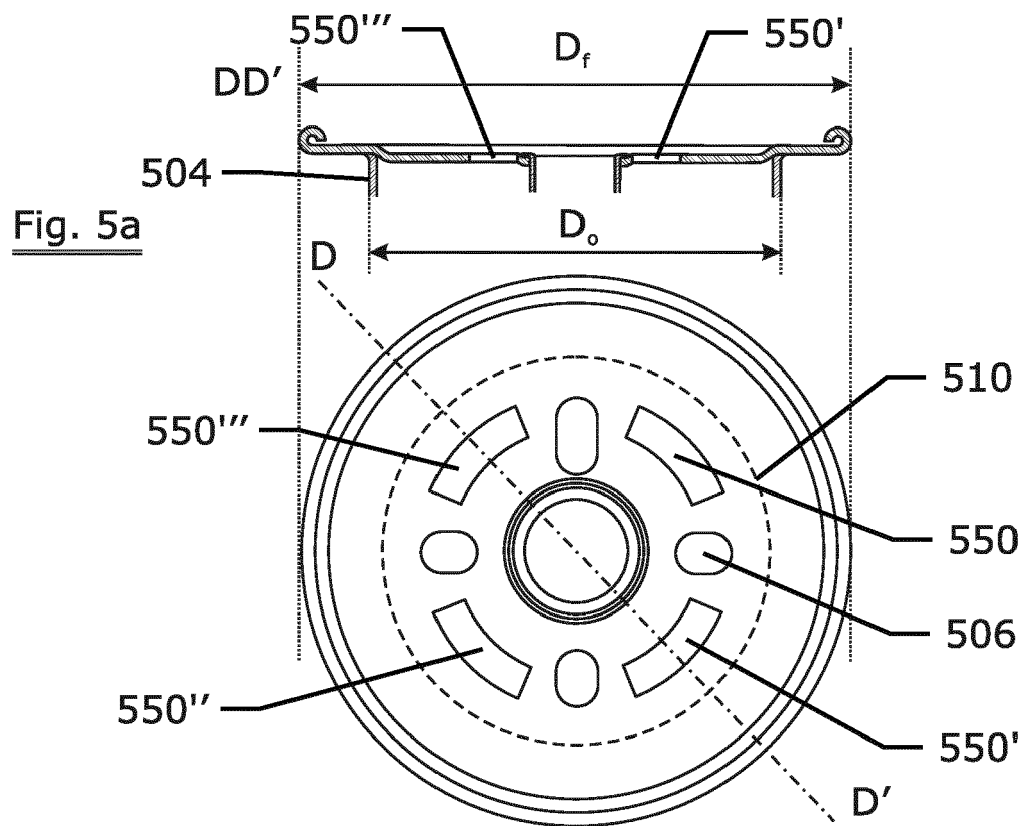


Fig. 5a

Fig. 5b

Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 20 15 2346

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	US 3 396 919 A (VAYDA WILLIAM C) 13 August 1968 (1968-08-13) * column 2, lines 61-69; figures 1-3 *	1,4-6	INV. B65H75/14 B65H75/30
X,D	US D 504 806 S (BASARAN MURAT [CN] ET AL) 10 May 2005 (2005-05-10) * figures 1,2 *	1,10	
X	US 5 460 333 A (VANHUYSE HERVE [BE]) 24 October 1995 (1995-10-24) * figure 6 *	1,10,14	
A		2-9, 11-13,15	
X	WO 2015/104315 A1 (BEKAERT SA NV [BE]) 16 July 2015 (2015-07-16) * paragraph [0052]; figure 6 *	1-6	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 29 May 2020	Examiner Pussemier, Bart
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 03.82 (P04C01)

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

EP 20 15 2346

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

29-05-2020

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3396919	A	13-08-1968	CH 461908 A	31-08-1968
			DE 1574354 A1	27-05-1971
			ES 337366 A1	16-02-1968
			FR 1510508 A	19-01-1968
			GB 1170004 A	12-11-1969
			SE 329308 B	05-10-1970
			US 3396919 A	13-08-1968

US D504806	S	10-05-2005	NONE	

US 5460333	A	24-10-1995	AT 153001 T	15-05-1997
			BR 9302924 A	22-02-1994
			CN 1085872 A	27-04-1994
			DE 69310621 D1	19-06-1997
			DE 69310621 T2	04-09-1997
			ES 2104043 T3	01-10-1997
			JP H06166467 A	14-06-1994
			KR 940001957 A	16-02-1994
			US 5460333 A	24-10-1995

WO 2015104315	A1	16-07-2015	CN 105916789 A	31-08-2016
			EP 3094586 A1	23-11-2016
			RU 2016133385 A	20-02-2018
			US 2016318732 A1	03-11-2016
			WO 2015104315 A1	16-07-2015

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 3396919 A [0006]