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(54) Title: HELICAL BENDING DEVICE

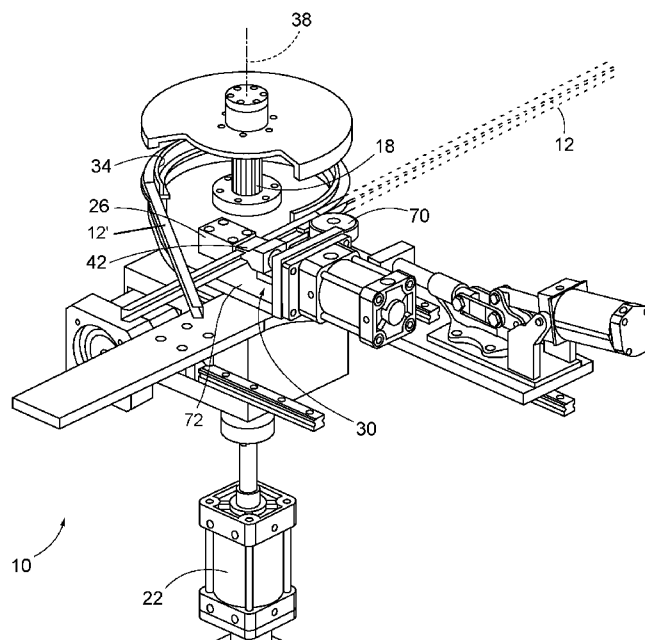


FIG. 1

(57) Abstract: A bending device for forming a product from a workpiece includes a shaft driven to rotate by a motor, an actuator including an extendable end configured to secure a portion of the workpiece, and a die coupled to the shaft and driven about an axis. The die includes a peripheral portion including a channel configured to receive the workpiece. The channel includes a first end and a second end offset from the first end in a direction parallel to the axis. Rotation of the die about the axis causes the workpiece to bend along the channel.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

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HELICAL BENDING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of prior-filed, co-pending U.S. Provisional Patent Application No. 62/343,391, filed May 31, 2016, the entire contents of which are incorporated by reference.

FIELD

[0002] The present disclosure relates to bending tools, and particularly to a channel bender.

SUMMARY

[0003] Fiber cable, such as all-dielectric self-supporting (ADSS) cable, is typically used for building and/or connecting fiber optic networks. An ADSS cable provides simple installation for distribution and transmission environments, since no support or messenger wire is required. Since it is not conductive, the ADSS cable may be used above ground neutral. A bracket may be provided for aerially storing and protecting an additional or reserve length of the cable and any associated splice points.

[0004] In one aspect, a bending device for forming a product from a workpiece includes a shaft driven to rotate by a motor, an actuator including an extendable end configured to secure a portion of the workpiece, and a die coupled to the shaft and driven about an axis. The die includes a peripheral portion including a channel configured to receive the workpiece. The channel includes a first end and a second end offset from the first end in a direction parallel to the axis. Rotation of the die about the axis causes the workpiece to bend along the channel.

[0005] In another aspect, a bending device for bending a workpiece includes a motor, a shaft coupled to the motor and driven to rotate by the motor, a block, a ram configured to secure a portion of the workpiece against the block, a die coupled to the shaft and driven about an axis, and a roller. The ram includes an extendable end. The die includes a peripheral portion including a channel configured to receive the workpiece. The channel includes a first end and a second end offset from the first end in a direction parallel to the axis. The roller is positioned

adjacent a portion of the channel, and the roller is configured to bias the workpiece against a wall of the channel as the die rotates.

[0006] In yet another aspect, a method for forming a cable storage bracket includes: positioning a portion of a workpiece within a channel of a die; securing a portion of the workpiece against movement; positioning a biasing member against the workpiece to bias the workpiece against a wall of the channel; and rotating the die about an axis to bend the workpiece to a configuration in which one end of the workpiece is bent about the axis beyond the other end of the workpiece, the one end being offset from the other end in a direction parallel to the axis.

[0007] Other aspects of the application will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a perspective view of a bending device.

[0009] FIG. 2 is a perspective view of the bending device of FIG. 1.

[0010] FIG. 3 is a perspective view of a portion of a bending device.

[0011] FIG. 4 is a perspective view of a die for the bending device of FIG. 3.

[0012] FIG. 5 is a perspective view of a workpiece formed by the bending device of FIG. 1.

[0013]

[0014] FIG. 6 is a plan view of a cable storage bracket.

[0015] FIG. 7 is a perspective view of a die according to another embodiment.

[0016] FIG. 8 is a plan view of the die of FIG. 7.

[0017] FIG. 9 is a side elevation view of the anvil of FIG. 7.

[0018] FIG. 10 is a perspective view of the anvil of FIG. 7 with an internal gear removed.

DETAILED DESCRIPTION

[0019] Before any embodiments are explained in detail, it is to be understood that the disclosure is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The disclosure is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of “including,” “comprising” or “having” and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. The terms “mounted,” “connected” and “coupled” are used broadly and encompass both direct and indirect mounting, connecting and coupling. Further, “connected” and “coupled” are not restricted to physical or mechanical connections or couplings, and can include electrical or hydraulic connections or couplings, whether direct or indirect. Also, electronic communications and notifications may be performed using any known means including direct connections, wireless connections, etc.

[0020] FIGS. 1 and 2 illustrate a bending device 10 for bending a workpiece 12 to form, e.g., a bracket 14 (FIG. 6) for storing a length of wire or cable, e.g., fiber optic cable (not shown). The device 10 includes a shaft 18, a motor 22 coupled to the shaft 18, a block 26, a ram 30, and a mandrel or die 34. The shaft 18 defines an axis of rotation 38 and is rotated about the axis 38 by the motor 22. The block 26 is positioned adjacent an end of the die 34, and the ram 30 includes an end 42 that is extendable to engage the block 26. In the illustrated embodiment, the ram 30 is a linear actuator (e.g., a hydraulic cylinder).

[0021] As shown in FIG. 3 and 4, the die 34 has a round profile and includes a channel 50 extending along an outer periphery. The channel 50 extends in a generally helical shape around the axis of rotation 38 and includes a first end 54 and a second end 58. In the illustrated embodiment of FIGS. 3 and 4, the channel 50 extends through one full revolution around the axis 38, and the first end 54 is positioned adjacent the second end 58, although the first end 54 and the second end 58 are offset from one another in a direction parallel to the axis 38. In some embodiments (FIGS. 1 and 2), the channel may not form a closed profile and the first end and second end may not be positioned adjacent one another.

[0022] As shown in FIGS. 1 and 2, the helical shape of the channel 50 creates an axial offset between the ends of a workpiece 12, permitting the ends of the workpiece 12 to be over bent, or bent beyond the point at which the two ends will be positioned adjacent one another. In the illustrated embodiment, the channel 50 is positioned between an upper flange 62 and a lower flange 66. The flanges 62, 66 can control swedging or movement of the workpiece 12 during bending to ensure that the workpiece 12 is bent along the desired profile. In the illustrated embodiment, a roller 70 (FIGS. 1 and 3) is positioned adjacent the die 34, and the workpiece is positioned between the roller 70 and the die 34. The roller 70 biases the workpiece 12 against the die 34 as the die 34 rotates.

[0023] To form the bracket 14, an end of an elongated workpiece 12 (FIG. 1) is positioned within the channel 50 on the outer surface of the die 34. In one embodiment, the workpiece 12 is formed from aluminum. The ram 30 is extended to retain a portion of the workpiece 12 against the block 26. Then, the motor 22 is actuated to rotate the shaft 18, thereby driving the die 34 about the axis 38. In the illustrated embodiment, the ram 30 and die 34 are secured to the same support member 72 (FIG. 1), and both the ram 30 and the die 34 are rotated by the shaft 18 about the axis 38 (for example, as shown in FIG. 1, the ram 30 and die 34 may rotate in a clockwise direction as viewed from the top of the axis 38). In the illustrated embodiment, the roller 70 and the associated biasing structure remain stationary as the die 34 rotates. As the die 34 rotates, the workpiece 12 is bent or wrapped around the outer periphery of the die 34 (e.g., by the roller 70). The workpiece 12' (FIG. 1) is bent such that one end is positioned adjacent an opposite end of the workpiece 12', but is bent or rotated beyond the opposite end.

[0024] When the ram 30 is retracted away from the block 26, the ends of the workpiece 12 may spring back such that the ends do not overlap one another to the extent shown in FIGS. 1 and 2. As shown in FIG. 5, the workpiece 12 is removed from the die 34. Referring now to FIG. 6, braces or cross-members 74 are positioned across the workpiece 12 to extend between the sides of the workpiece 12. The end of each cross-member 74 is joined (e.g., by welding) to one side of the workpiece 12, forming the bracket 14 as shown in FIG. 6. The cross-members 74 provide reinforcement and increase the rigidity and strength of the bracket 14.

[0025] The storage bracket 14 includes a first end where the two ends of the workpiece 12 are brought together and a second end opposite the first end. In the illustrated embodiment, the storage bracket 14 forms a teardrop shape, with the first end forming a wedge portion 82 and the second end forming a round portion 86. The diameter of the round portion 86 is dependent on, among other things, the stiffness of the workpiece material and the workpiece's moment of inertia. The amount of spring back of the workpiece 12 can be controlled, and the bracket 14 may be formed without the need to weld the ends of the workpiece 12 together. The overbending of the workpiece 12 also reduces or eliminates weld cracking on the cross-members 74.

[0026] FIGS. 7-10 illustrate a die 434 according to another embodiment. The die 434 of FIGS. 7-10 is similar to the die 34 of FIG. 4, and similar features are identified with similar reference numbers, plus 400. In particular, the die 434 includes a channel 450 only including a lower flange 466 without an upper flange. In addition, the die 434 includes an internal gear surface or spline 490 that meshes with a pinion gear 494 coupled to the shaft 418. In other embodiments, the die 434 may be coupled to the shaft 418 in a different manner.

[0027] As shown in FIG. 9, the helical shape is defined by the channel 450. For example, the pitch of the bent workpiece 12 is determined by the web height and the axial offset between the first end 454 and the second end 458 of the channel 450.

[0028] Although certain aspects have been described in detail with reference to certain preferred embodiments, variations and modifications exist within the scope and spirit of one or more independent aspects as described. Various advantages and features are set forth in the following claims.

CLAIMS

What is claimed is:

1. A bending device for forming a product from a workpiece, the bending device comprising:

a shaft driven to rotate by a motor;

an actuator including an extendable end, the end configured to secure a portion of the workpiece; and

a die coupled to the shaft and driven about an axis, the die including a peripheral portion including a channel configured to receive the workpiece, the channel including a first end and a second end offset from the first end in a direction parallel to the axis, rotation of the die about the axis causing the workpiece to bend along the channel.

2. The bending device of claim 1, further comprising a roller positioned adjacent a portion of the channel, the roller configured to bias the workpiece toward the channel as the die rotates.

3. The bending device of claim 1, wherein the first end and the second end are offset from one another in an angular direction about the axis.

4. The bending device of claim 1, wherein the first end and the second end are positioned adjacent one another with respect to an angular direction about the axis.

5. The bending device of claim 1, wherein the channel is formed by a peripheral wall and at least one flange protruding from the peripheral wall.

6. The bending device of claim 5, wherein the at least one flange includes a pair of flanges, wherein the channel is configured to receive at least a portion of the workpiece between the flanges.

7. A bending device for bending a workpiece, the bending device comprising:
 - a motor;
 - a shaft coupled to the motor and driven to rotate by the motor;
 - a block;
 - a ram configured to secure a portion of the workpiece against the block, the ram including an extendable end;
 - a die coupled to the shaft and driven about an axis, the die including a peripheral portion including a channel configured to receive the workpiece, the channel including a first end and a second end offset from the first end in a direction parallel to the axis; and
 - a roller positioned adjacent a portion of the channel, the roller configured to bias the workpiece against a wall of the channel as the die rotates, such that rotation of the die about the axis causes the workpiece to bend along the channel.
8. The bending device of claim 7, wherein the first end and the second end are offset from one another in an angular direction about the axis.
10. The bending device of claim 7, wherein the first end and the second end are positioned adjacent one another with respect to an angular direction about the axis.
11. The bending device of claim 7, wherein the channel is formed by a peripheral wall and at least one flange protruding from the peripheral wall.
12. The bending device of claim 11, wherein the at least one flange includes a pair of flanges, wherein the channel is configured to receive at least a portion of the workpiece between the flanges.
13. The bending device of claim 7, wherein the die includes a spline surface, the bending device further comprising a gear driven by the shaft and engaging the spline surface.

14. A method for forming a cable storage bracket, the method comprising:
 - positioning a portion of a workpiece within a channel of a die;
 - securing a portion of the workpiece against movement;
 - positioning a biasing member against the workpiece to bias the workpiece against a wall of the channel; and
 - rotating the die about an axis to bend the workpiece to a configuration in which one end of the workpiece is bent about the axis beyond the other end of the workpiece, the one end being offset from the other end in a direction parallel to the axis.
15. The method of claim 14, further comprising removing a bending force to permit the one end of the workpiece to retract to a position adjacent the other end.
16. The method of claim 15, further comprising moving the one end and the second end to be aligned in a common plane.
17. The method of claim 14, further comprising securing a first leg of the workpiece and a second leg of the workpiece to form the cable storage bracket.
18. The method of claim 17, wherein securing the first leg and the second leg includes securing at least one cross-member between the first leg and the second leg.
19. The method of claim 14, wherein rotating the die includes bending the workpiece along the channel in a helical shape.

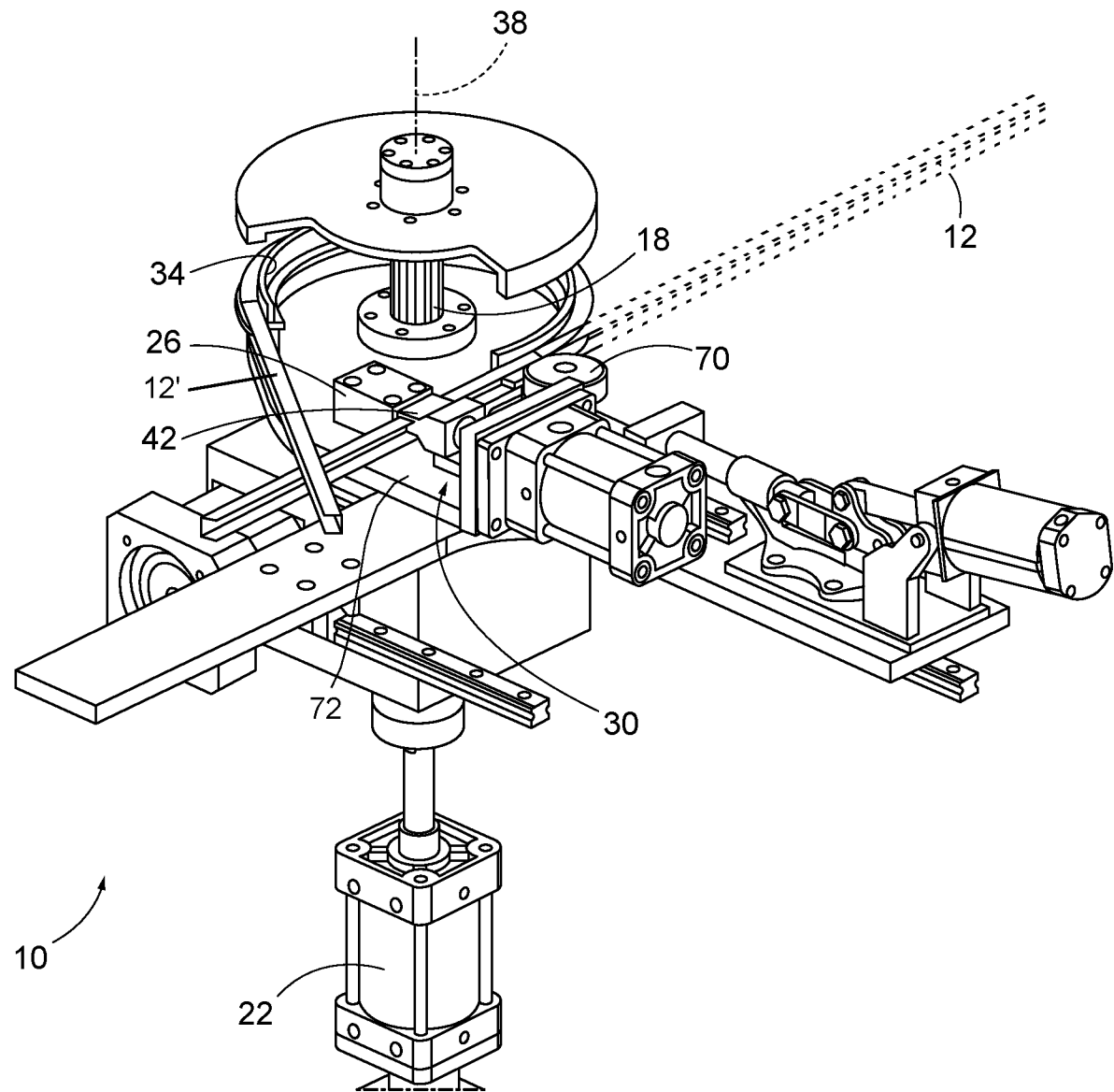


FIG. 1

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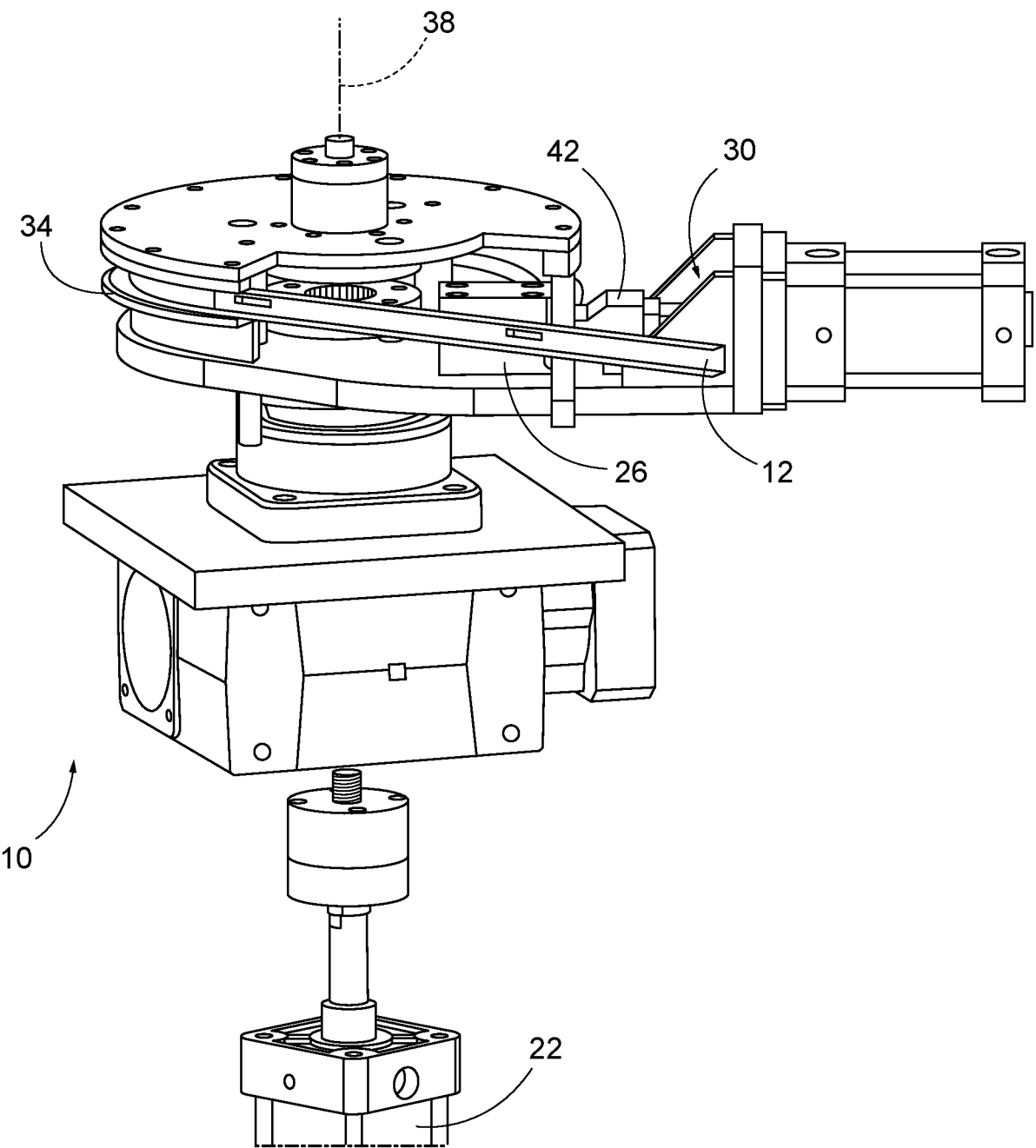


FIG. 2

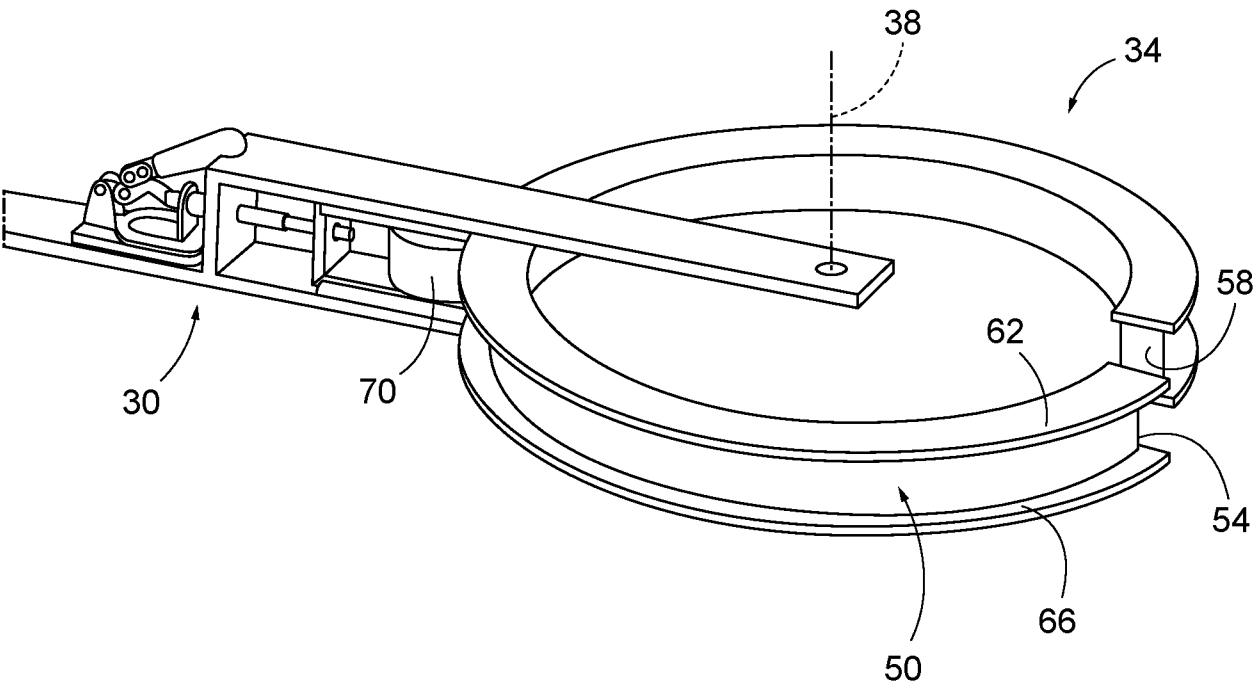


FIG. 3

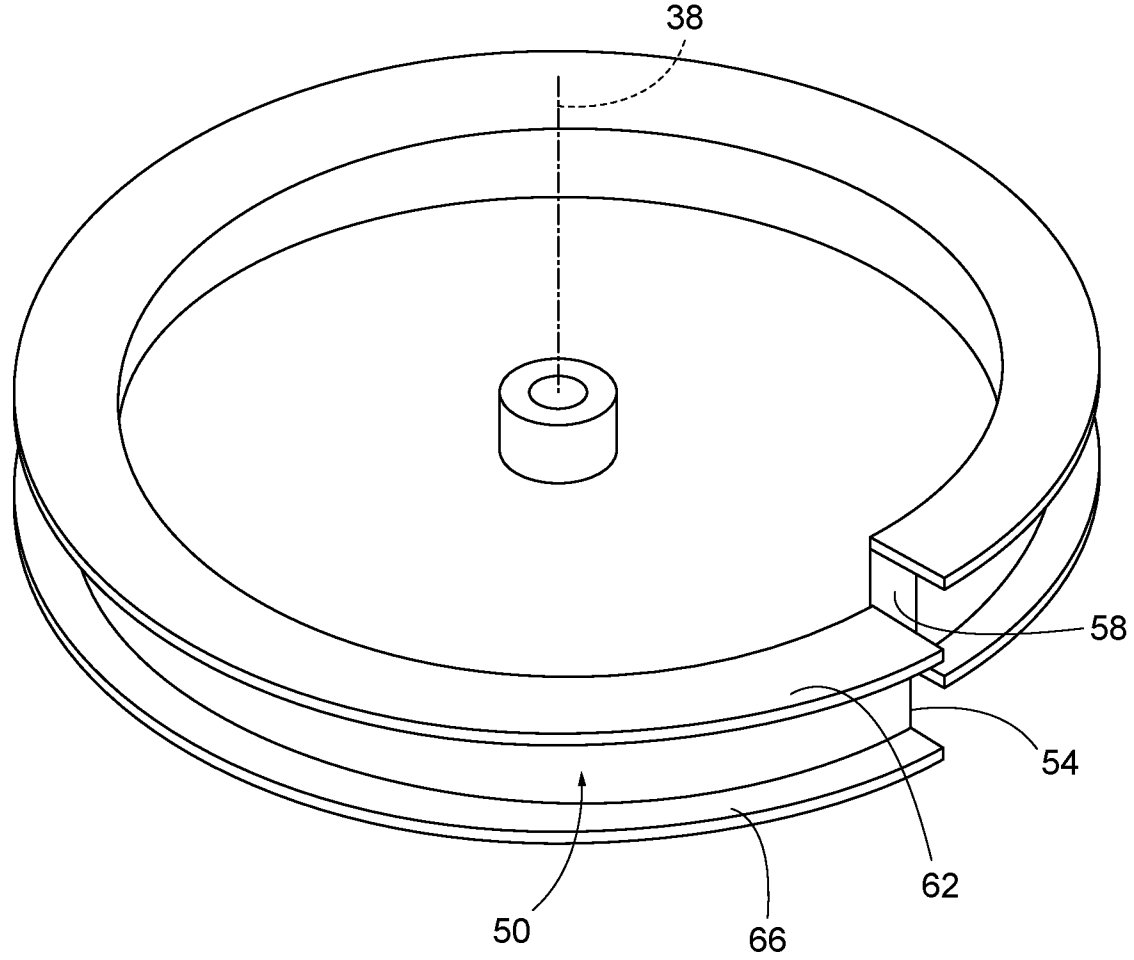


FIG. 4

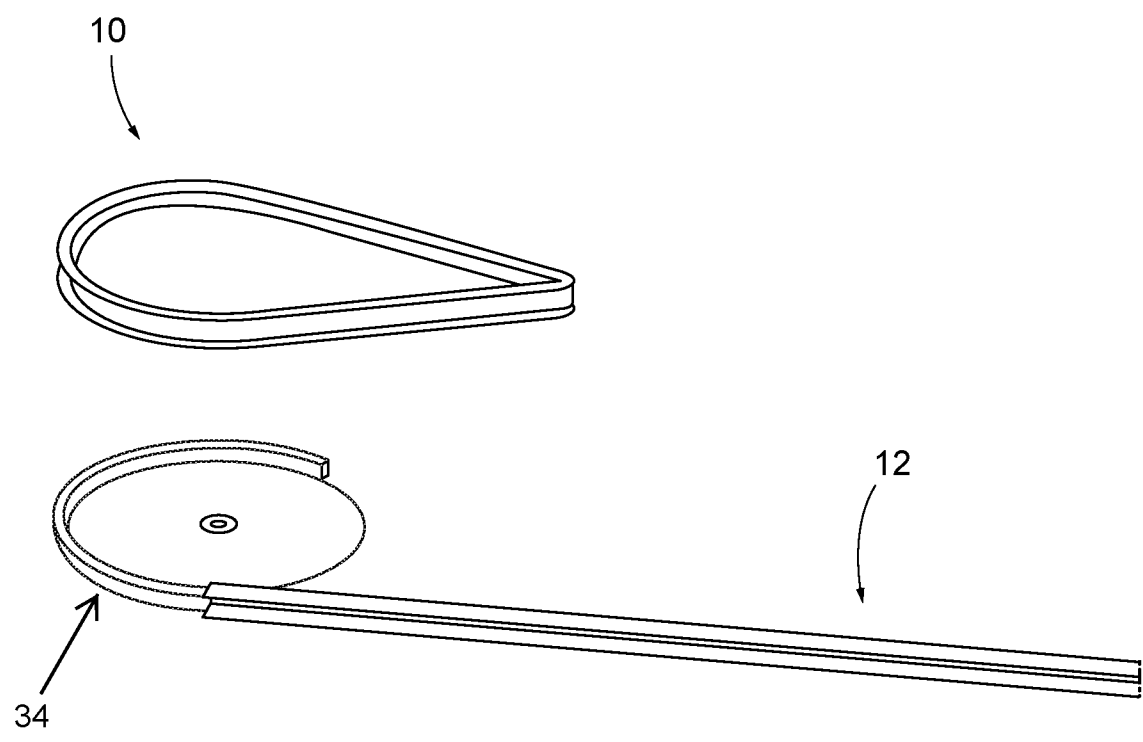


FIG. 5

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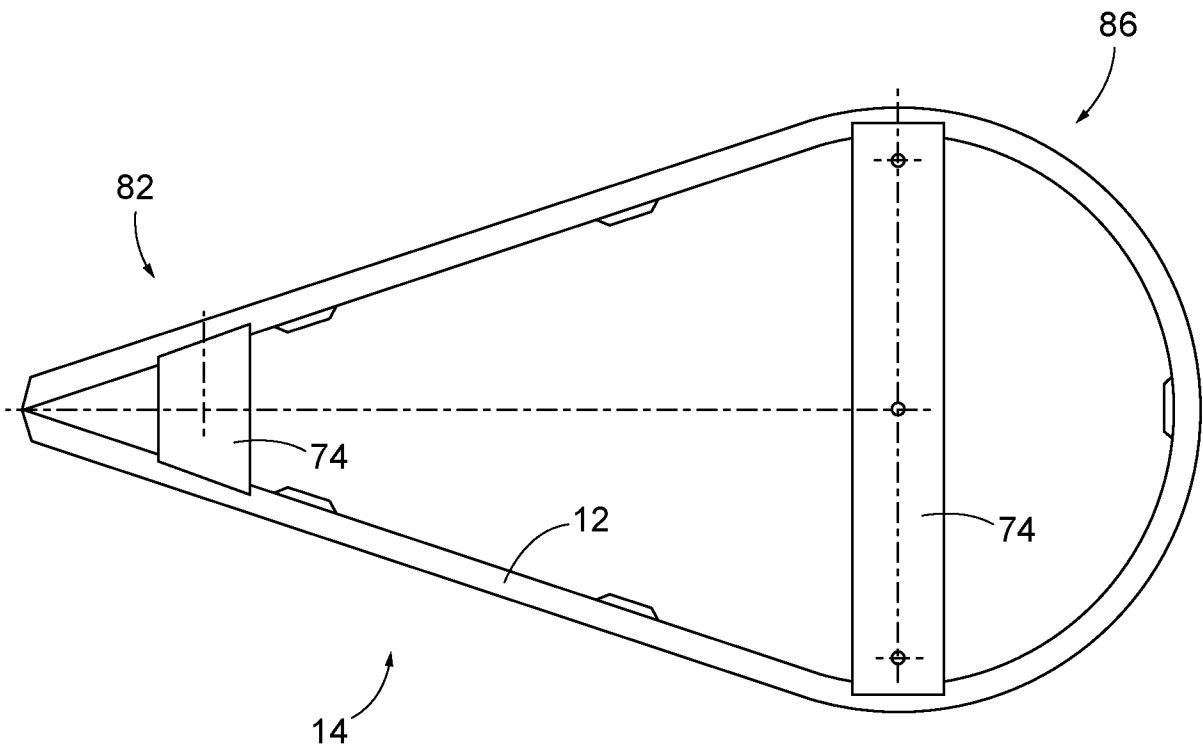


FIG. 6

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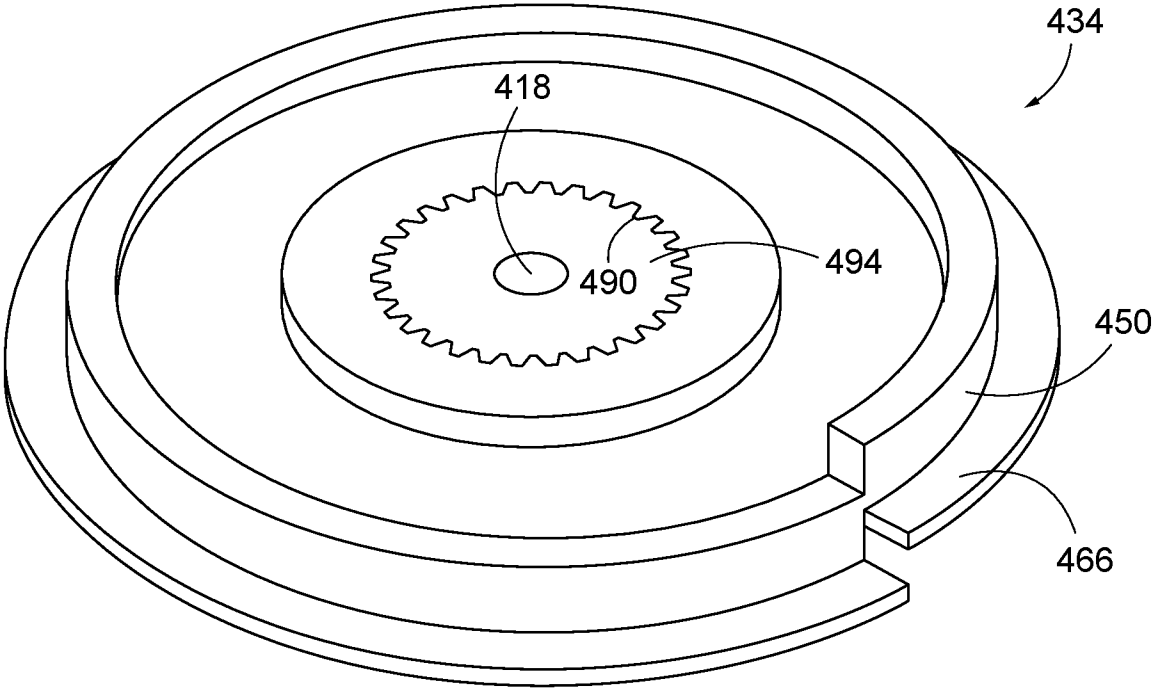


FIG. 7

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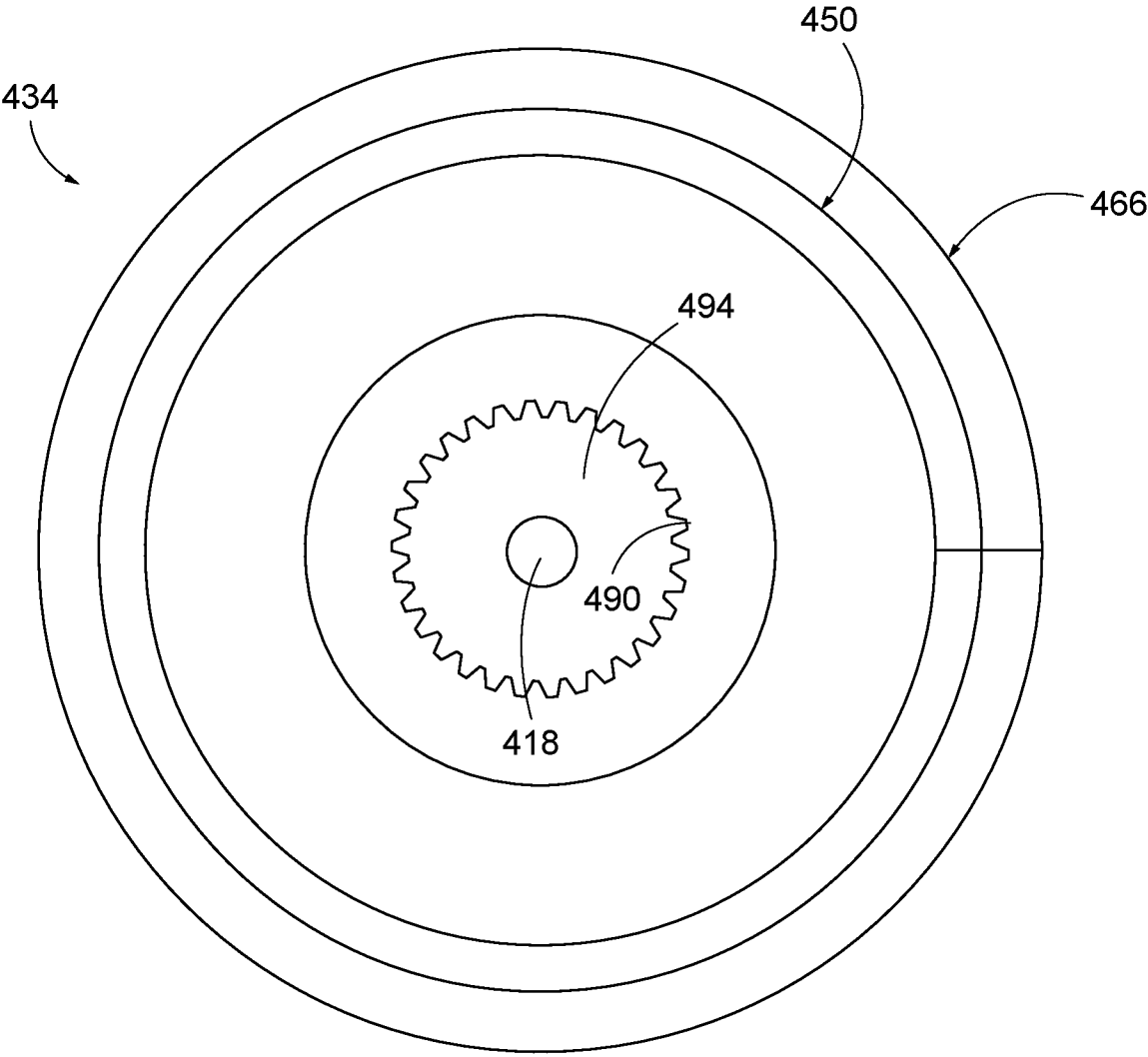


FIG. 8

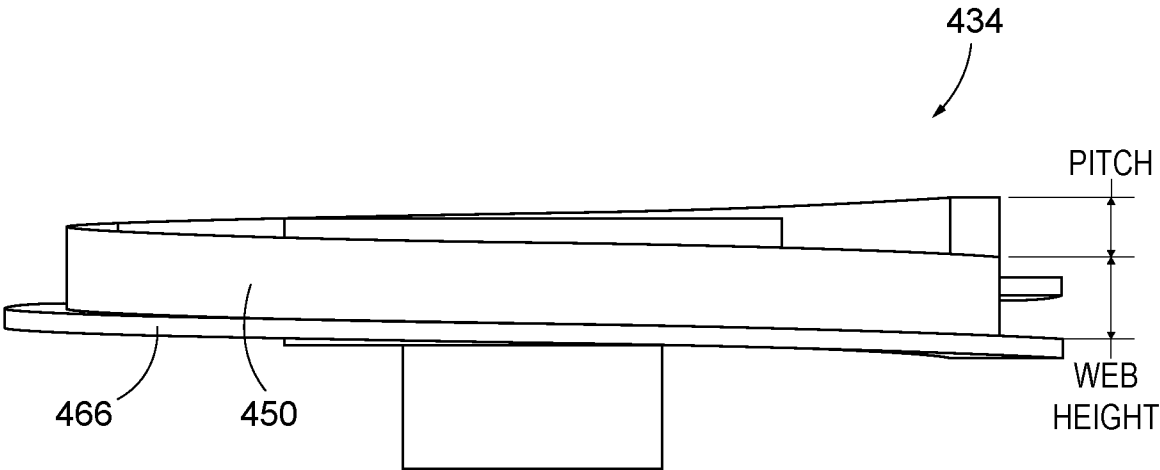


FIG. 9

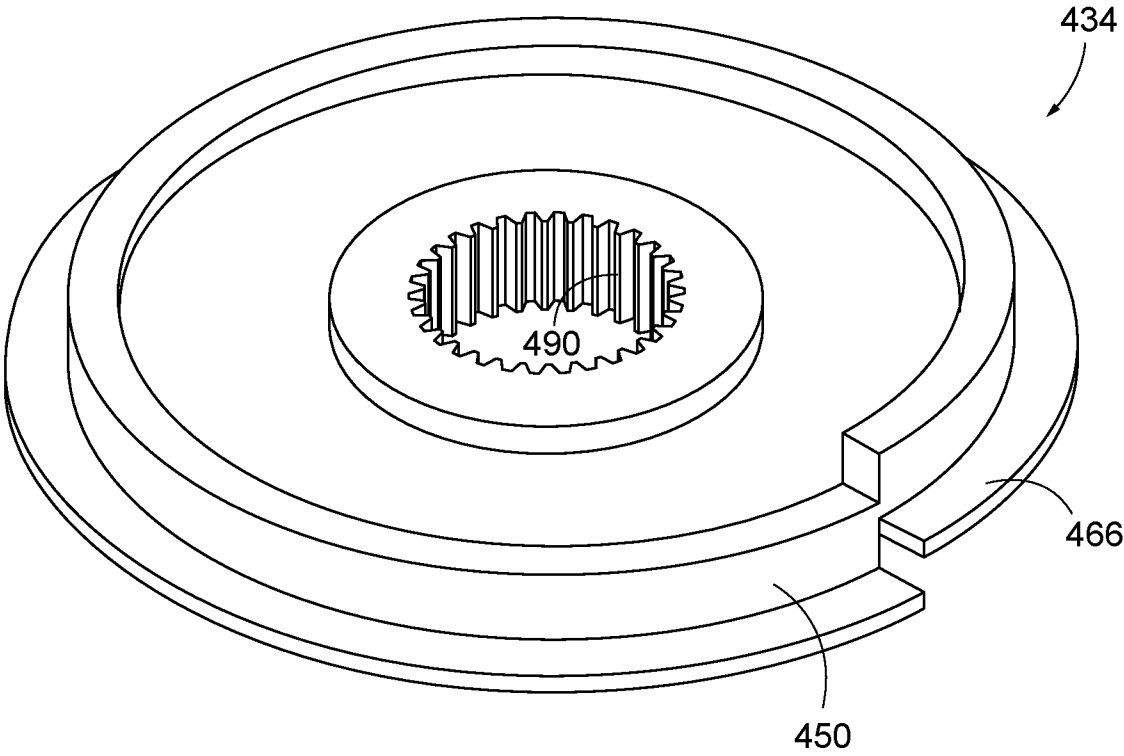


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2017/035199

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B21D 7/024; B21D 7/00; B21D 7/02; B21D 7/025; B21D 7/04; B21D 7/08; B21D 9/00 (2017.01)

CPC - B21D 7/024; B21D 7/00; B21D 7/02; B21D 7/04; B21D 7/08; B21D 9/00; B21D 11/06 (2017.05)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC - 72/146; 72/149; 72/154; 72/155; 72/159; 385/135 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,843,858 A (GRIMM et al) 04 July 1989 (04.07.1989) entire document	1-8, 10-13
Y	US 217,870 A (GROSHANS) 29 July 1879 (29.07.1879) entire document	1-8, 10-13
Y	US 5,345,803 A (CUTTER) 13 September 1994 (13.09.1994) entire document	2, 7, 8, 10-13
Y	US 1,542,355 A (BARKER) 16 June 1925 (16.06.1925) entire document	5, 6, 11, 12
A	US 2002/0003939 A1 (HERMSEN et al) 10 January 2002 (10.01.2002) entire document	1-8, 10-19
A	US 2008/0193096 A1 (JONES et al) 14 August 2008 (14.08.2008) entire document	1-8, 10-19
A	US 5,408,571 A (KAPLAN) 18 April 1995 (18.04.1995) entire document	1-8, 10-19

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search

25 July 2017

Date of mailing of the international search report

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