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(54) Crimp die

(57) The present invention relates to crimp dies (10), adapted for crimping a crimping portion of a contact terminal onto an electrical cable, which crimp dies (10) comprise two crimping legs (12, 14) extending in the crimping direction and defining a curved crimping surface (16) therebetween.

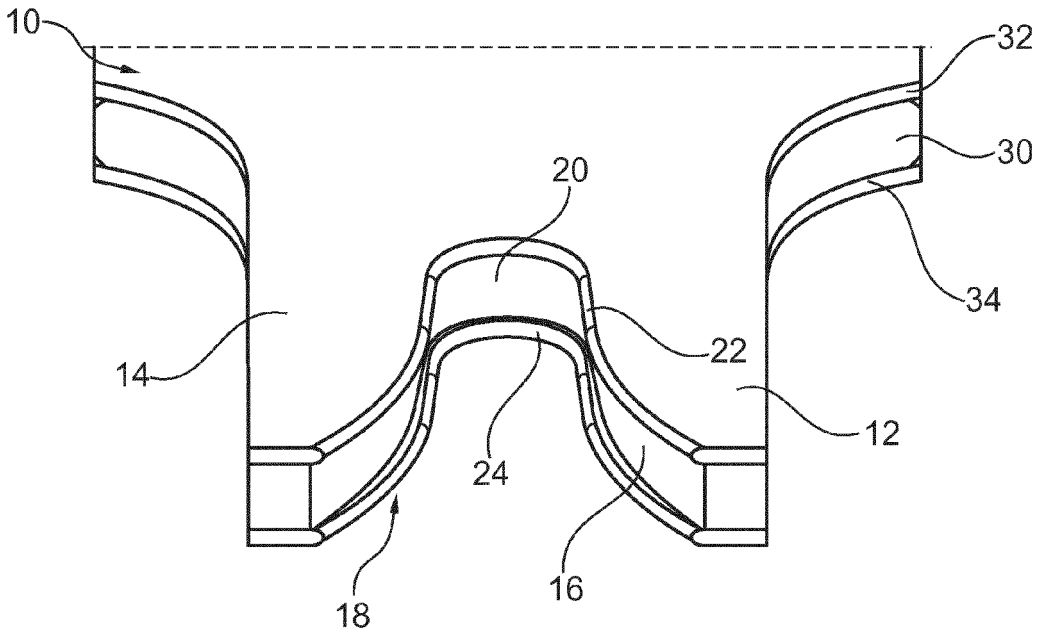

Fig. 1

EP 2 790 278 A1

Description

1. Field of the invention

[0001] The present invention relates to a crimp die for crimping a crimping portion of a contact terminal onto an electrical cable, in particular onto a single wire seal of an electrical cable.

2. Technical background

[0002] In order to mechanically and electrically couple electrical contact terminals to electrical cables, commonly contact terminals are provided with crimping wings, which can be crimped around the striped wires of the electrical cables as well as to the insulation of the cables. Commonly used terminals usually comprise a pair of wire crimping wings, which upon crimping are bent around a corresponding dismantled cable portion and another pair of insulating or sealing crimping wings, which upon crimping are bent around the insulating material of the electrical cable or around a cable or wire seal. In other words, upon crimping a contact terminal to the electrical cable, the insulation or sealing crimping wings are bent around a non-dismantled portion of the electrical cable, i.e. around the cable insulation and / or a sealing member such as a single wire seal, to establish a mechanical connection between the contact terminal and the cable.

[0003] The crimping in industrial sized production processes is achieved by automated crimping apparatuses that comprise different crimp dies for the crimping of the wire crimping wings and the insulating or sealing crimping wings of the respective contact terminals. A typical prior art example of a crimping tool used for crimping a contact terminal to an electrical cable is described in document US 5,415,015. Therein, crimp dies are described which can be used for example in a hand crimp tool, i.e. a plier-like hand tool used for manually crimping of contact terminals to electrical cables. According to this document, the crimp dies comprise separate sections for crimping insulation crimping wings, for example to a cable insulation, and wire crimping wings for crimping onto the dismantled cable stands. The crimping method described therein results in insulation crimping wings, which are bent around a cable insulation in an essentially round shape and wire crimping wings, which are bent essentially forming a B-shape.

[0004] A further prior art example of crimp dies is described in document EP 2 485 343. In this document an attempt is described to overcome the problem that after crimping the contact terminals can get stuck in the crimping tools. For example, according to this document the crimped contact terminal can get stuck in the contour of the corresponding crimp die after crimping. To solve this problem, it is suggested to provide a crimping anvil with a particular opening angel and a correspondingly formed B-shaped crimp die to facilitate removal of the crimp contact terminals after crimping.

[0005] Yet a further prior art crimping tool for crimping an insulation crimping portion of a contact terminal to a cable insulation is described in document DE 197 37 863. According to this document, a round shape of the crimped insulation crimp wings is achieved making use of a crimp die with an essentially round shaped inner crimping surface. In order to avoid edges of the insulation crimping wings of the terminal to cut into the cable insulation, it is suggested to taper the free ends of the insulation crimping wings.

[0006] One problem of the prior art crimping processes and crimp dies used is that they tend to damage the cable insulation and / or the sealing arranged on the cable due to the edges of the crimped wings cutting into the respective material. While this is even desired for the crimping onto the dismantled cable strands, it is highly problematic with the crimping to the cable insulation or any sealing members, since the desired mechanical connection is weakened thereby. A further problem is that the commonly used material silicon for the single wire seals reacts very sensitively to tiny scratches or cuts. Even a small cut, as it typically occurs upon crimping of the crimping wings onto such a sealing member of silicon, increases highly the risk that the whole sealing member fails, if one applies pulling forces to the cable provided with the sealing member.

[0007] In view of the above, it is an object of the present invention to provide a crimp die for crimping a crimping portion of a contact terminal onto an electrical cable, which overcomes the above problems and which in particular reduces the risk of damages to the cable insulation or any sealing member upon crimping of an electrical contact terminal to an electrical cable. It is a particular object of the present invention to provide a crimp die for crimping insulation or sealing crimping wings to a cable insulation or to a seal member such that the risk of damaging the insulation or sealing member due to the crimping wings is reduced.

[0008] These and other objects which will become apparent upon reading the following description are solved by a crimp die according to claim **1.**

3. Summary of the invention

[0009] According to the invention, a crimp die is provided which is adapted for crimping a crimping portion of a contact terminal onto an electrical cable, which crimp die comprises two crimping legs extending parallel to each other in the crimping direction and defining a curved crimping surface there between. The width of the crimping surface as seen in the direction of the longitudinal axis of any contact terminal to be crimped is confined by at least two rims protruding in crimping direction. Thereby, upon using the crimp die, the two protruding rims can come e.g. into contact with the surface of the insulation or seal member depressing the elastic material to some extent during the actual crimping process, i.e. during the crimping of the crimping wings around the insulation or

seal member. When the crimp die is removed after the crimping process is complete, the displaced material of the cable insulation or the seal member will resiliently spring back, so that a robust mechanical connection is achieved, whereby at the same time the surface of the cable insulation or seal member is not damaged by the edges of the crimping wings.

[0010] The skilled person will understand that for the purposes of description herein at some instances relative orientations with regard to a contact terminal to be crimped are used, such as "as seen in the direction of the longitudinal axis of any contact terminal", without that the contact terminal necessarily forms part of the claimed invention.

[0011] Preferably, the two crimping legs define a u-shaped cross-section in a plane perpendicular to the longitudinal axis of the contact terminal to be crimped, as it is also known for example from the above mentioned EP 2 458 343. The u-shape cross section facilitates the crimping process and in particular the reception of the terminal and cable to be crimped between the two crimping legs.

[0012] The crimp die can be made from one single integral part but it may also be assembled from several parts. In a preferred embodiment, the crimping legs are part of a first metal plate, which can for example be mounted to a corresponding crimping apparatus. The protruding rims are part of second and respective third metal plates, which can for example be arranged on opposite main sides of the first plate in a contacting arrangement, thereby sandwiching the first metal plate. Preferably, the second and third plates have a contour, which is essentially identical to the contour of the first plate, i. e. they also comprise for example two legs defining a u-shaped cross-section. However, as seen in crimping direction, the rims protrude to some extent further than the crimping surface. This has the advantageous effect, that upon using the crimp die of the invention, the protruding rims will come into contact with the insulation or sealing member of the electrical cable, thereby displacing the material to some extent during the crimping process. The use of second and third plates for providing the protruding rims allows the cost efficient manufacturing of the crimp die of the present invention, since the manufacturing of three relatively simple plates is simpler than the manufacturing of an integrated crimp die comprising corresponding protruding crimping rims.

[0013] As it will become more apparent from considering the provided figures, the protruding rims and the crimping surface preferably form a groove. The groove is most preferably adapted for the reception of the corresponding crimping wings of the contact terminal to be crimped. In other words, when the electrical terminal is arranged in a corresponding crimping apparatus and the inventive crimp die is applied thereon, the crimping wings of the terminal are arranged between the two protruding rims. Preferably, the dimensions of the crimp die of the invention should be such that the protruding rims are as close as possible to the crimping wings of the terminal, when in use. Thereby, the material of the cable insulation or sealing member is effectively displaced in the proximity of the outer edges of the crimping wings of the terminal, whereby any risk for damages to the insulation or sealing is effectively reduced. Generally preferred, the protruding rims have a rounded surface to prevent any damages to the insulation or sealing member of the cable.

[0014] The present invention also relates to a system for crimping a crimping portion of a contact terminal onto an electrical cable. As the skilled person will recognize, the above described inventive crimp die is intended to be used for crimping a contact terminal comprising wings onto an electrical cable, and in particular onto a cable insulation or a sealing member, such as a single wire seal provided on the electrical cable. Thus, the expression "to be crimped onto a cable" encompasses a direct as well as an indirect crimping onto the cable.

[0015] The inventive crimp die can be used in automatic crimping apparatuses for large scale industrial crimping processes. To this end, the crimp die is provided for example as exchangeable part, which can be mounted to a corresponding crimping apparatus in an assembly line. However, the inventive crimp die may also be used in hand held crimp tools, as they are commonly used in workshops etc.

[0016] A method for using the crimp die of the present invention for crimping a contact terminal onto an electrical cable comprises usually the steps of providing a crimping apparatus as mentioned above, which includes an inventive crimp die, for example mounted therein. Then, a contact terminal comprising crimping wings as they are commonly known for example from the initially discussed prior art documents is provided in the crimping apparatus. Thereafter, or at the same time, an electrical cable is arranged in or onto the contact terminal, such that the crimping wings of the terminal are disposed in the desired relation to the electrical cable, respectively any sealing provided on the cable. Preferably, a single wire seal is likewise provided on the cable, either before or after arranging the cable onto the contact terminal. Finally, the crimping wings of the contact terminals are crimped by means of the inventive crimp die on to said single wire seal respectively onto for example the cable insulation. Due to the protruding rims being arranged on both sides of the crimping surface (as seen in the direction of the longitudinal axis of the contact terminal to be crimped), the rims will displace the material of the sealing or cable insulation to some extent, such that it is not damaged by the sharp edges of the crimping wings upon closing of the crimp.

4. Description of the preferred embodiments

[0017] In the following, the invention is described exemplarily with reference to the enclosed figures, in which:

Fig 1 shows a three-dimensional illustration of a

crimp die in accordance with the present invention;

Fig. 2 shows a three-dimensional view of the crimping process utilizing the crimp die of Fig. 1;

Fig.3 shows a detail of the illustration of Fig. 2 seen from a different perspective;

Fig. 4 is a schematic side view of the illustration of Fig. 2;

Fig. 5 is a side cross-sectional view of a detail of Fig. 4; and

Fig.6 is a cross-sectional schematic view of a detail of Fig. 4 taken along a plane at A-A.

[0018] Fig. 1 shows a crimp die 10 in accordance with the present invention in a three-dimensional, perspective view. All the illustrations of the enclosed figures are up-to-scale illustrations, whereby the different elements are shown enlarged for clarity reasons. In practice, the width (e.g. from the outer edge of the left leg to the outer edge of the right leg) for example of the crimp die 10 of Fig. 1 is in the range of 15 to 20 mm and the die is adapted to crimp terminals with an overall longitudinal length of maybe 20 to 50 mm.

[0019] As one can tell from Fig. 1, the crimp die 10 comprises first and second legs 12,14 which extend parallel to each other in the crimping direction. The skilled person will recognize that the "crimping direction" is the direction in which the die has to be moved for the crimping process. The two legs 12 and 14 define a curved crimping surface 16 therebetween. The crimping surface extends parallel to the longitudinal axis of the contact terminal to be crimped and will upon crimping come into contact with the crimping wings of the terminal and will thus bend the same in the desired crimp shape. As it is common in the art, the two crimping legs 12,14 define a u-shaped cross-section in a plane perpendicular to the longitudinal axis of the contact terminal to be crimped. The skilled person will recognize that with this type of crimp die comprising two crimping legs defining u-shaped cross-section, any contact terminal will extend perpendicular to the main plate of the crimp die 10. The crimping surface 16 comprises an enlarged entrance portion 18, which is achieved by the particular shape of the first and the second legs 12,14. This entrance portion 18 facilitates the introduction of the corresponding crimping wings of a contact terminal. The entrance portion 18 narrows to offer an essentially funnel shape up to the bottom portion 20. As it can be seen from Figure 1, the width (as seen in longitudinal direction of the contact terminal to be crimped when arranged in the crimping position) of the crimping surface 16 is confined by two rims 22 and 24, which protrude in crimping direction.

[0020] In the embodiment shown in the figures, the crimp die 10 is assembled from essentially three steel plates, a first plate 30 forming the crimping surface 16 and the second 32 and third 34 plates providing each a rim 22, respectively 24 protruding in crimping direction. The second and third plates 32 and 34 are arranged on opposite main sides of the first plate 30 and are in contact with said main sides of the first plate. When in use, the three plates can for example be mounted in a corresponding crimping apparatus and clamped therein in the configuration shown in the figures. Alternatively, the three plates may be firmly attached to each other, for example by welding or by suitable fastening means such as screw and nut means or similar. Although the crimp die as shown in Fig. 1 could likewise be provided in form of one integral metal part, the shown configuration made of three plates is preferred, since the manufacturing of three separate plates as shown is more cost efficient than the manufacturing of one single integrated part.

[0021] As one can further derive from the figures, the two rims 22 and 24 have a rounded surface, and second and third plate each have a contour, which is essentially identical to the contour of the first plate. Thereby, by arranging the three plates adjacent to each other as shown in Fig. 1, automatically the desired shape results, whereby in particular the protruding rims and the crimping surface 16 from a groove adapted to receive the crimping wings of a terminal. The expression "rims protruding in crimping direction" in the present case means relative to the crimping surface. As will be explained in more detail below, thereby the soft material of the cable insulation or any single wire seal can be protected from being damaged by the crimping wings of an electrical contact terminal. The groove shape can best be seen in Fig. 5.

[0022] Turning now to Fig. 2, the use of the crimp die is explained in more detail. In Figure 2, one can see the crimp die 10 of Figure 1 and a corresponding crimp anvil 11. Anvil and crimp die are for example mounted in a suitable crimping apparatus, as they are generally known to the skilled person. Onto the crimp anvil 11 a contact terminal 40 is arranged. The contact terminal 40 comprises a spring cage 42 for the reception of a corresponding contact pin of another contact terminal. In the shown example, the contact terminal comprises a first pair of crimping wings 43, which serve for the mechanical and electrical connection of the contact terminal with the stripped wire 57 of an electrical cable 50. In addition thereto, the contact terminal 40 comprises a second pair of crimping wings, namely so called insulating or seal crimping wings 44. While the wire crimping wings 43 serve in particular for the establishing of an electrical connection with the cable 50, the insulating or seal crimping wings 44 are mainly provided for a firm mechanical connection of the contact terminal 40 with the cable 50. The electrical cable 50 comprises a cable insulation 52 and a number of cable wires 57. The cable insulation 52 is removed at the free end of the cable 50 to allow en electrical connection with the wires 57 by means of the wire crimping wings 43. Additionally, in the shown configuration, a single wire seal 54 is provided over the insulation 52 of the cable. The insulating or seal crimping wings 44 are crimped around a seal crimp portion 56 of the single wire seal 54.

[0023] From Fig. 2 and 3 one can clearly see that the

two protruding rims and the crimping surface 16 form a groove, which is dimensioned respectively adapted for the reception of the crimping wings 44 of the contact terminal 40. In other words, the crimping surface 16 has a width, as seen in the direction of the longitudinal axis of the contact terminal to be crimped, which is slightly larger than the corresponding width of the crimping wings 44. From Fig. 2 one can also derive, that the crimping surface 16 extends in a direction parallel to the longitudinal axis of terminal 40.

[0024] Turning back to Fig. 1, one can see that the protruding rims 22 and 24 are provided over essentially the whole inner length of the crimping legs including the bottom portion 20. This configuration is preferred, although for the positive effects of the invention it is sufficient that protruding rims exist in the area of the bottom portion 20 of the crimp die 10. In particular at the entrance portion 18 of the crimp die 10 the protruding rims are not strictly necessary. The reason for that is, that the rims at the entrance portion 18 will not come into contact with the surfaces of the insulation, respectively the sealing member upon crimping. It is in particular the portion of the rims 24 and 22 at or near the bottom portion 20, which provide the advantageous disposition of the material of the insulation or the sealing member and which reduces the risks that the edges of the crimping wings 44 cut into the surface of the insulation or the sealing member.

[0025] In the position shown in Figure 2, the crimp die 10, i.e. the crimping surface 16, is in contact with the free ends of the crimping wings 44, but the actual crimping process has not yet started. The skilled person will recognize that upon movement of the crimp die 10 into the crimping direction, i.e. downwards in Fig. 2, the two crimping wings 44 will roll inwardly and bend over the seal crimp portion 56 of the single wire seal 54. At the end of the crimping process, when the crimping wings 44 are almost bent into their final position, the protruding rims 22 and 24 will dispose the material of the single wire seal 54 likewise downwardly, i.e. away from the edges of the crimping wings 44, thereby protecting the single wire seal 54 from damages. It should be noted that in practice, the disposition of the material of the single wire seal 54 is in the range of a millimeter or a fraction of a millimeter only. However, such a small displacement is sufficient to prevent the edges of the crimping wings 44 from cutting into the material of the single wire seal, respectively the cable insulation 52.

[0026] Fig. 3 shows a detail of the configuration of Fig. 2 seen from the opposite side. In Fig. 3, one can clearly see the sealing lips 55 of the single wire seal 54 as well as the seal crimp portion 56 thereof.

[0027] In Fig. 4, a side view is shown of the process shown in Figs. 2 and **3.** Fig. 4 shows that the width of the crimping surface 16 as seen in the direction of the longitudinal axis of the contact terminal is slightly larger than the width of the crimping wings 44. Further, one can see from this illustration how the crimping surface 16 is confined in this direction by the two rims 22 and 24.

[0028] Fig. 5 shows a detail of the illustration of Fig. 4 in a cut view. In this view the crimping wings 44 are bent into their final configuration. As one can see from Fig. 5, the two rims 22 and 24 slightly displace the material of the single wire seal 54 in the area of the crimping wings 44, so that the edges of the wings 44 do not cut into the surface of the seal 54. To this end, it is advantageous that the rims 22 and 24 protrude in relation to the crimping surface in crimping direction to an extent corresponding to the material thickness of the crimping wings, most preferably protruding for 10 to 50% more as the material thickness of the crimping wings 44. Since the material of the single wire seal 54, respectively of the cable insulation 52 if no seal is provided, is resilient, the material will go back into the initial configuration as soon as the crimping die 10 is removed. Thus, a secure and firm fixation of the contact terminal 40 onto the cable insulation or single wire seal can be achieved, without the edges of the crimping wings 44 cutting into the soft material of the insulation or seal.

[0029] Fig. 6 is a cross-sectional view taken along a cut A-A of Fig. **4.** From Fig. 6 it can be seen, how the crimping wings 44 are completely bent around the seal crimp portion 56 of the single wire seal 54. Since the rims 22 and 24 protrude in crimping direction relative to the crimping surface the soft material of the seal, respectively the insulation, is displaced during the end of the crimping process and thereby moved away from the edges of the crimping wings.

List of reference numbers:

Crimp die	10
Crimp anvil	11
Crimping legs	12, 14
Crimping surface	16
Entrance portion	18
Bottom portion	20
Protruding rims	22, 24
First plate	30
Second plate	32
Third plate	34
Contact terminal	40
Spring cage	42
Wire crimping wings	43
Insulation or seal crimping wings	44
Electrical Cable	50
Cable insulation	52
Single wire seal	54
Sealing lips	55
Seal crimping portion	56
Cable wires	57

Claims

1. Crimp die (10), adapted for crimping a crimping portion of a contact terminal onto an electrical cable, which crimp die (10) comprises two crimping legs (12, 4) extending in the crimping direction and defining a curved crimping surface (16) therebetween, **characterized in that** the width of the crimping surface (16) as seen in the direction of the longitudinal axis of the contact terminal to be crimped is confined by at least two rims (22, 24) protruding in crimping direction.

2. Crimp die in accordance with claim 1, **characterized in that** the two crimping legs (12,14) define a u-shaped cross-section in a plane perpendicular to the longitudinal axis of the contact terminal to be crimped.

3. Crimp die in accordance with claims 1 or 2, **characterized in that** the crimping legs (12,14) are part of a first metal plate (30) and the rims are part of second (32) and respective third (34) metal plates.

4. Crimp die in accordance with claim 3, **characterized in that** the second (32) and third (34) plates are arranged on opposite main sides of the first plate (30) and being in contact with said respective main sides of the first plate.

5. Crimp die in accordance with any of the preceding claims 3 or 4, **characterized in that** the second (32) and third (34) plates have a contour essentially identical to the contour of the first plate (30).

6. Crimp die in accordance with any of the preceding claims, **characterized in that** the protruding rims (22, 24) and the crimping surface (16) form a groove.

7. Crimp die in accordance with any of the preceding claims, **characterized in that** the protruding rims (12, 4) and crimping surface (16) form a groove adapted for the reception of crimping wings of a contact terminal.

8. Crimp die in accordance with any of the preceding claims, **characterized in that** the protruding rims (12, 4) have a rounded surface.

9. Crimp die in accordance with any of the preceding claims, **characterized in that** the crimping surface (16) extends in a direction parallel to the longitudinal axis of the terminal.

10. Crimp die in accordance with any of the preceding claims, **characterized in that** the protruding rims (12, 4) are provided over essentially the whole inner lengths of the crimping legs.

11. System for crimping a crimping portion of a contact terminal onto an electrical cable, comprising a crimp die (10) in accordance with any of the preceding claims, an electrical cable (50) and at least one contact terminal (40) comprising crimping wings (44) to be crimped onto the electrical cable.

12. Crimping apparatus for crimping a crimping portion of a contact terminal onto an electrical cable (50) comprising at least one crimp die (10) according to any one of the preceding claims 1 to 10.

13. Method for crimping a contact terminal onto an electrical cable, comprising the steps of:

    - providing a crimping apparatus in accordance with claim 12;
    - providing a contact terminal (40) comprising crimping wings (44);
    - providing an electrical cable (50);
    - arranging the cable (50) onto the contact terminal (40);
    - arranging a single wire seal (54) onto the cable (50);
    - crimping the crimping wings (44) of the contact terminal (40) by means of the crimp die (10) onto the single wire seal.

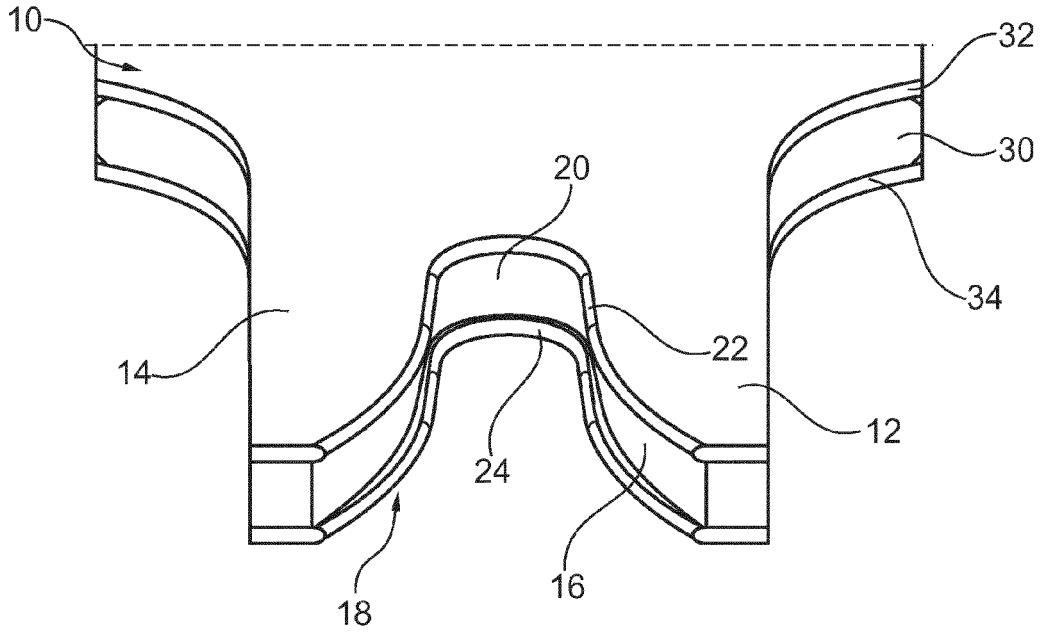
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Fig. 1

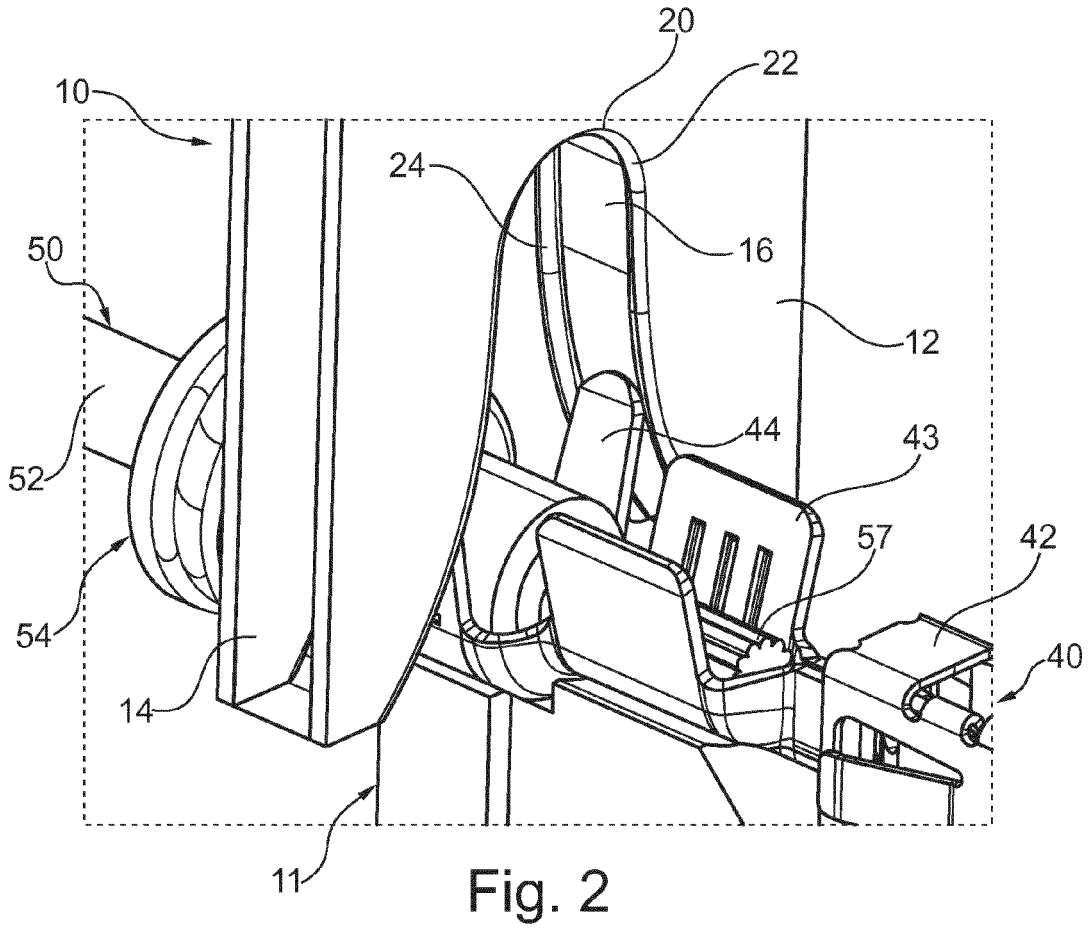
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Fig. 2

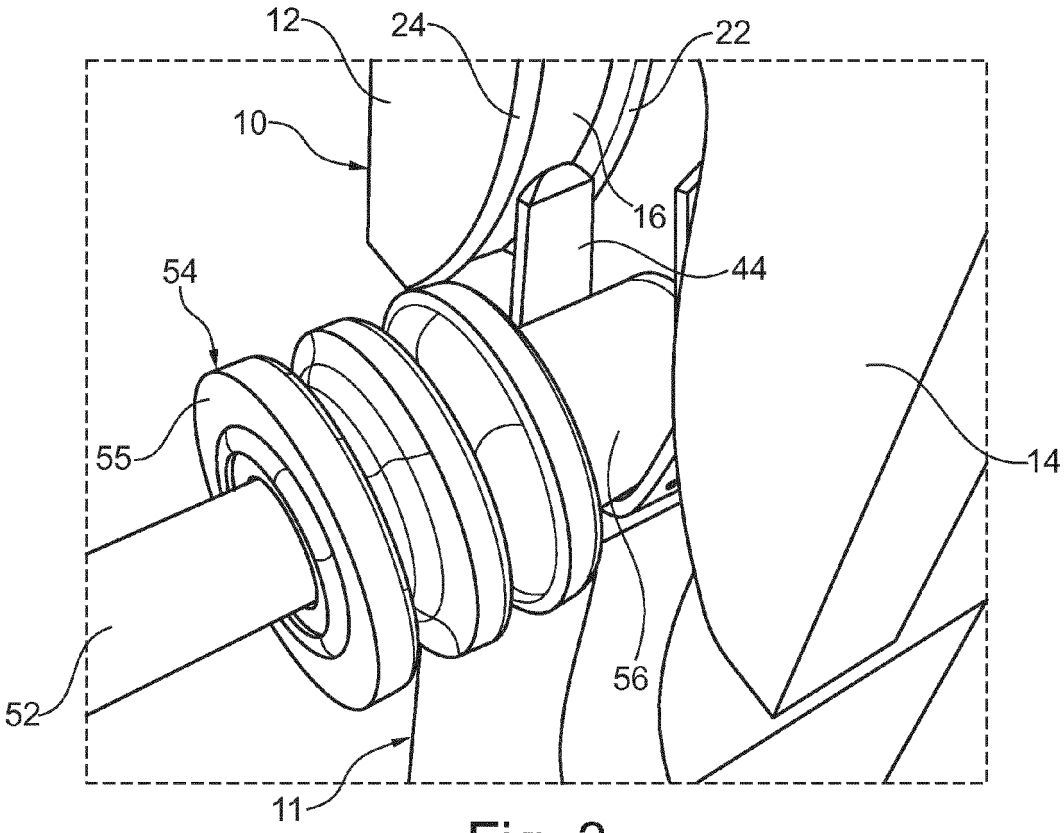
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Fig. 3

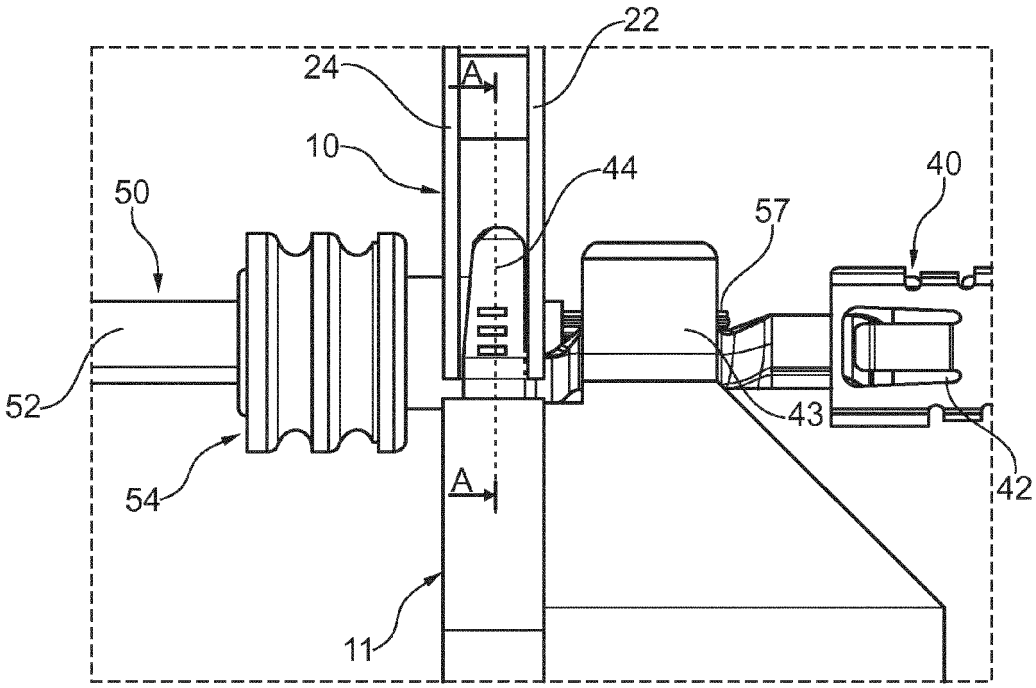
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Fig. 4

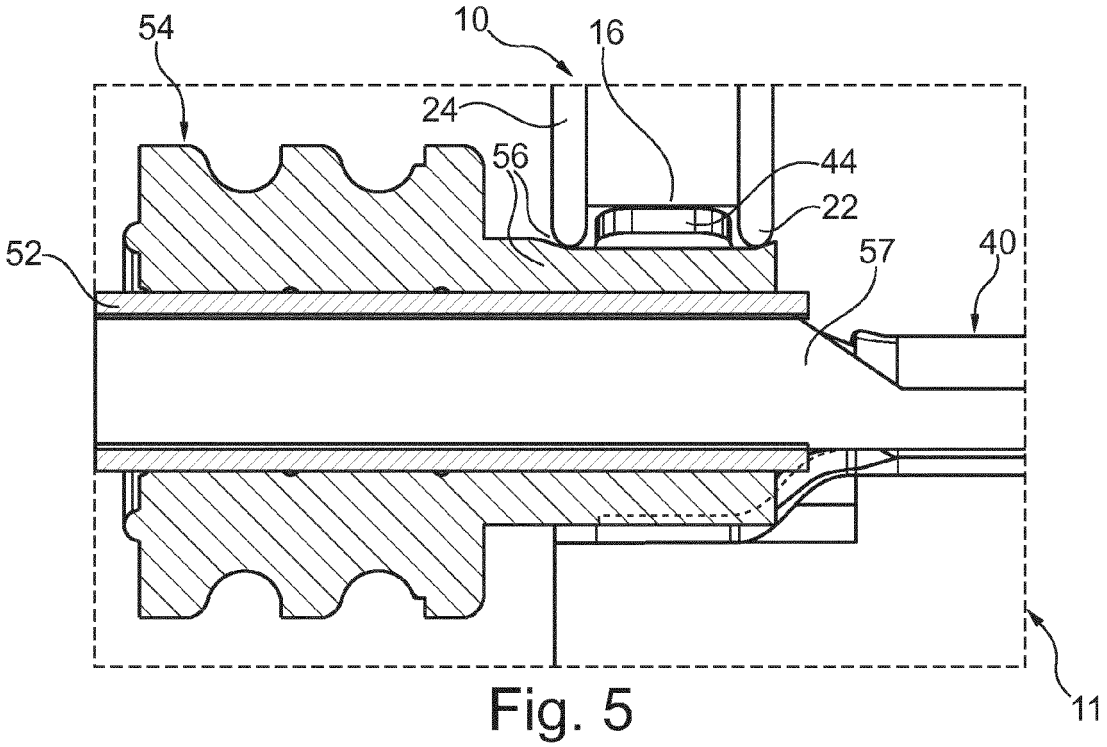

Fig. 5

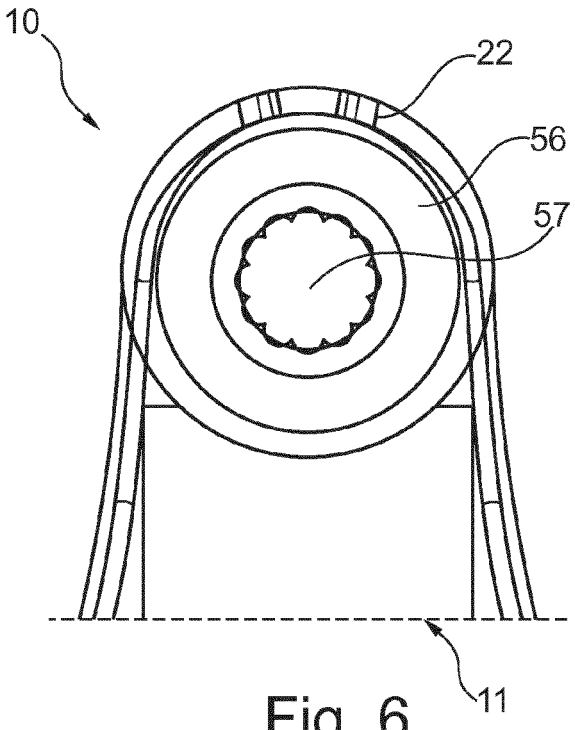

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 13 16 3361

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	CH 681 836 A5 (ULRICH BLECHER) 28 May 1993 (1993-05-28) * figures 1-13 * * page 4, lines 56-61 *	1,2,6-13	INV. H01R43/058 ADD. H01R4/18
X	FR 2 574 994 A1 (ELECTRICITE DE FRANCE [FR]) 20 June 1986 (1986-06-20) * figures 4,5,7a *	1,2,6, 8-13	
X	US 3 241 098 A (COBAUGH ROBERT F ET AL) 15 March 1966 (1966-03-15) * figures 5,6 *	1-4,6, 9-13	
X	WO 2009/115860 A1 (FRAMATOME CONNECTORS INT [FR]; JOSSIFIDIS ILIAS [DE]; BAUER ANDREAS [D) 24 September 2009 (2009-09-24) * figure 5b *	1-7,9-13	

TECHNICAL FIELDS SEARCHED (IPC)
H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 September 2013	Hugueny, Bertrand

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 16 3361

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17-09-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CH 681836 A5	28-05-1993	NONE	
FR 2574994 A1	20-06-1986	NONE	
US 3241098 A	15-03-1966	NONE	
WO 2009115860 A1	24-09-2009	CN 102037622 A	27-04-2011
		EP 2266170 A1	29-12-2010
		WO 2009115860 A1	24-09-2009

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 5415015 A **[0003]**
- EP 2485343 A **[0004]**
- DE 19737863 **[0005]**
- EP 2458343 A **[0011]**