(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 865 457 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.04.2015 Bulletin 2015/18

(51) Int Cl.:
B08B 9/055 *(2006.01)*

(21) Application number: **14190258.5**

(22) Date of filing: **24.10.2014**

(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

(30) Priority: **25.10.2013 NO 20131413**

(71) Applicant: **Fras Technology AS**
1431 As (NO)

(72) Inventor: **Fjerdingstad, Sølve**
1410 Kolbotn (NO)

(74) Representative: **Onsagers AS**
P.O. Box 1813 Vika
0123 Oslo (NO)

(54) Pipeline pig

(57) A pipeline pig (10) for inspection and cleaning of an inner wall (13) of a pipeline (12) is described. The pipeline pig comprises an elongate body (15) having a forward end portion (16) and a rear end portion (17), and a central portion (18) which, during pigging of a pipeline (12), is adapted to clean the inner wall (13) of the pipeline. The pipeline pig (10) is provided with a camera unit (21) such that the camera unit, during pigging of a pipeline (12), can take images and/or video film of the inner wall (13) of the pipeline. The pipeline pig (10), during pigging of a pipeline (12), is independent of external connecting means such as hoses, cables and/or other means.

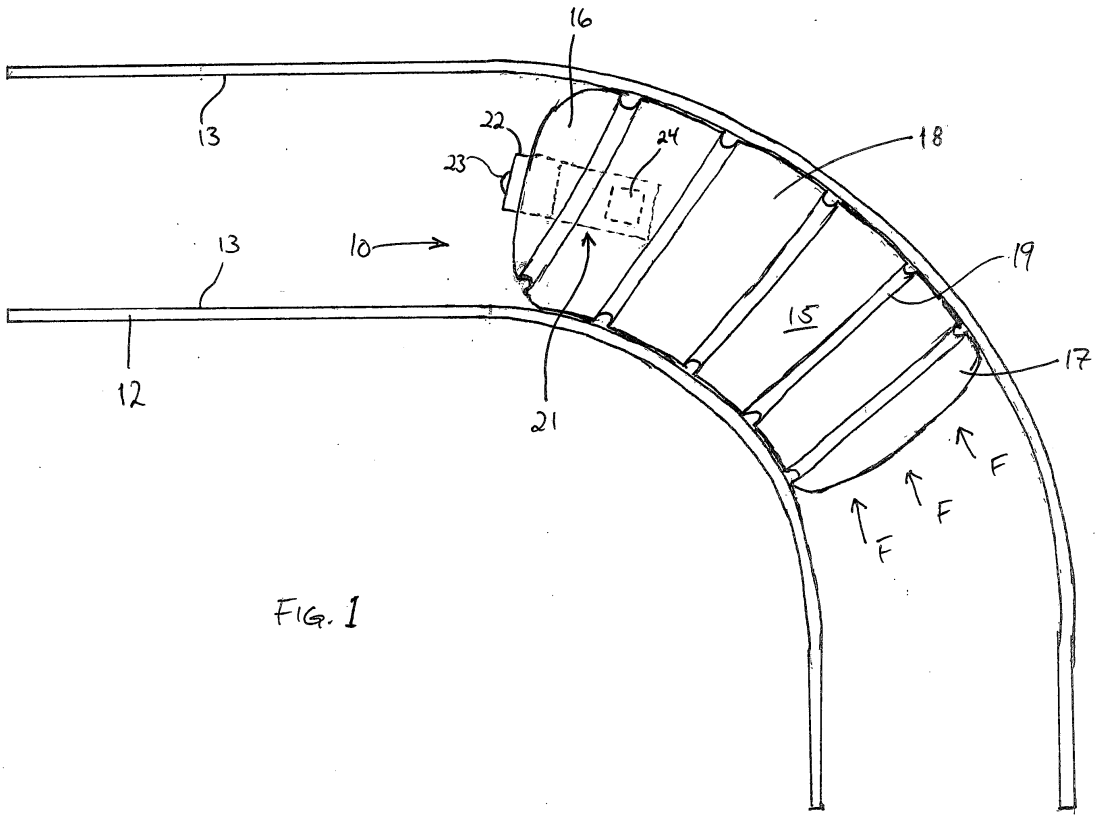

FIG. 1

EP 2 865 457 A1

Description

[0001] The present invention relates to a pipeline pig for simultaneous inspection and cleaning of a pipeline.

[0002] Today, internal cleaning of a pipeline and inspection of the pipeline to detect damage thereto are two different operations carried out using a different type of equipment, by different people and at different times.

[0003] Specially made cleaning pigs for internal scraping and cleaning of pipelines exist. However, these cleaning pigs are not made to be able to carry out inspection of the pipeline as the pig is run through it. Pipeline inspection systems usually comprise a specially designed tractor or similar device capable of moving internally back and forth in a pipeline and are provided with a camera for inspection of the pipeline. Connected to the device are cables, hoses and the like that extend back through the pipeline to an operator. The device can be controlled through the cables and signals can be transmitted through them from the camera back to receiver equipment monitored by the operator. Hoses, pipes and the like transfer a fluid under pressure for propulsion of the device. Alternatively, the device can be pushed in and pulled out of the pipeline. This requires the connection of a pipe or the like that is relatively rigid. The known devices therefore require a great deal of equipment at the location where the inspection is to take place, and since the devices are connected to cables, hoses and the like, they also have a highly limited range.

[0004] The object of the present invention has therefore been to facilitate cleaning and checking of pipelines and to provide equipment for cleaning and inspection of pipelines that has as simpler design than the known systems.

[0005] Another object has been to make the equipment less costly to produce and simpler to use than today's known systems.

[0006] This is achieved by means of a pipeline pig as defined in independent claim 1. Additional embodiments of the pipeline pig are defined in dependent claims 2-15.

[0007] A pipeline pig is provided for inspection and cleaning of an internal wall of a pipeline. The pipeline pig comprises an elongate body with a forward end portion and a rear end portion in relation to the direction of travel of the pig during pigging of a pipeline, and a central portion which, during pigging of a pipeline, is adapted to clean the inner wall of the pipeline. The pipeline pig is provided with a camera unit such that the camera unit, during pigging of a pipeline, is able to take images (i.e., still images) and/or video film of the inner wall of the pipeline. During pigging of a pipeline, the pipeline pig is independent of external connecting means, i.e., that the pipeline pig is without external physical connections, such as hoses, cables and/or other means, and is pushed through the pipeline by means of a pressurised fluid, i.e., a liquid or a gas, but preferably a liquid, which pushes the pipeline pig through the pipeline by exerting a force on the rear end portion of the pig.

[0008] The fact that the pipeline pig body is elongate means that the length of the pig is greater than its diameter. The result of this is that the forward portion of the body, where the camera unit's camera is located, remains in front when the pipeline pig is run though a pipeline. The pipeline pig can preferably be rotated about its own longitudinal axis, i.e., a central axis through the forward portion, central portion and rear portion of the body which is substantially coaxial with the longitudinal central axis of the pipeline through which the pig is run, but is, because of the body's elongate form, unable to rotate about other axes as it is run through the pipeline.

[0009] The fact that the pipeline pig is independent of external connecting means, i.e., without physical connections, during the pigging of a pipeline means, inter alia, that the pipeline pig is not connected to pipes, hoses or the like that push or pull the pipeline pig through the pipeline or that supply the pig with a fluid under pressure that is used to move the pipeline pig through the pipeline. This also means that the pipeline pig is not connected to signal cables, electrical cables or other types of cable for control of the pipeline pig, supply of electric power to the pig, transfer of video film and/or image recordings or the like.

[0010] As the pipeline pig has no physical connections when it is run through a pipeline, the pig, during pigging of a pipeline, is preferably adapted to be driven through the pipeline by a pressurised fluid that presses on the rear end portion of the pig. Since the pipeline pig is not connected to hoses, cables and other similar means during pigging, it can be run through the pipeline over a much longer distance than would have been possible had the pipeline pig been connected to hoses, cables and/or similar means.

[0011] The pipeline pig body, as mentioned, comprises a central portion that preferably extends between the forward end portion and the rear end portion and is adapted to clean the inner wall of the pipeline. Therefore, the central portion of the body preferably has an external diameter that is as large as or larger than the internal diameter of the pipeline. This means that the size of the pipeline pig, especially the central portion of the body, is adapted to the internal diameter of the pipeline such that the central portion presses against the inner wall of the pipeline with a required force to ensure that desired cleaning of the inner wall of the pipeline is achieved. The surface of the central portion can in a known way also be configured so as to ensure that the cleaning effect is optimal. The surface of the central portion can optionally also be provided with scraping means that will improve the ability of the pipeline pig to remove material that is stuck to the inner wall of the pipeline.

[0012] The body is preferably configured with at least one cavity that extends inside the body from the forward end portion of the body. The camera unit is arranged in the at least one cavity such that the camera unit, during pigging of a pipeline, can take images and/or video film of the inner wall of the pipeline.

[0013] The body is preferably made of a flexible material such as a flexible plastic or rubber material. For example, a two-component foamed plastic, such as polyurethane, may be used, but other suitable materials may of course be also employed as long as they are so flexible as to be able to adapt to a certain degree to the inner diameter of the pipeline such that the pipeline pig can be introduced into the pipeline even if the pipeline pig body has a central portion having a diameter slightly larger than the internal diameter of the pipeline, and such that the pipeline pig can pass though bends and curves in the pipeline, and at the same time are not more flexible than as to allow the central portion to exert a desired pressure against the inner wall of the pipeline such that desired cleaning is accomplished.

[0014] The pipeline pig body may be provided with a helical groove that is formed in the outer surface of the body and extends from the rear end portion of the body to the forward end portion thereof. When the pipeline pig is pushed through a pipeline by means of a pressurised fluid, a small portion of the fluid will be pressed through the groove and, because of the helical form of the groove, will cause the pipeline pig to rotate about its own longitudinal axis. This combined rotational movement and axial displacement of the pipeline pig through the pipeline will further improve the ability of the pig to clean the inner wall of the pipeline.

[0015] The camera unit preferably comprises at least one camera and a memory unit for storage of images and/or video film taken by the camera. The camera unit is also provided with a battery having sufficient capacity for operation of the camera unit whilst the pipeline pig is sent through the pipeline or the part of the pipeline that is to be pigged. Since image and/or video film recordings are stored in a suitable memory unit in the pipeline pig, the pig can be made much simpler than known devices for inspection of pipelines as the use of signal cables for transfer of images and/or video film is avoided. In addition, the present pipeline pig will have a larger range since it is independent of cables. The pipeline pig can thus be sent through a desired length of a pipeline whilst image and/or video recordings are made of the inner wall of the pipeline.

[0016] The camera unit may also be provided with a transmitter for wireless transfer of images and/or video film taken by the camera to a receiver unit external to the pipeline pig. This can typically be through use of Wi-Fi, Bluetooth or other types of signals capable of being used for wireless communication between two or more units. With wireless transfer of images and/or video film taken by the camera as the pipeline pig moves through the pipeline, an assessment can be made of the images and/or video film, and hence of the pipeline's integrity, in real time. At the same time, images and/or video film that are captured can be stored in a memory unit for optional more thorough examination after the pigging of pipelines has been completed.

[0017] The pipeline pig can also be provided with a positioning means for determining the position of the pig in a pipeline during pigging of the pipeline. This can, for example, be a GPS. The positioning means is preferably arranged in the camera unit. The image and/or video recordings can thus be provided with position data so that when, during an examination of image and/or video film recordings after the pigging operation, irregularities are discovered in the recordings, it is possible with the aid of the recorded position data to determine exact location or locations of the irregularities in the pipeline. The positioning means can advantageously be arranged in the cavity of the body, and is preferably incorporated in the camera unit.

[0018] The camera unit can be secured permanently in the cavity of the body, for example, in that the camera unit is glued in place in the cavity or moulded into the body during manufacture thereof. The pipeline pig can thus be made in a simple and inexpensive manner, and it is conceivable that the pig can be a disposable pipeline pig, i.e., that the pig is run through a pipeline once and is disposed of after the stored images and/or video data has been retrieved. Alternatively, the camera unit, or optionally only the memory unit, can be detachably arranged in the body cavity. The pipeline pig can thus be run multiple times through one or more pipelines.

[0019] The pipeline pig body may, of course, be provided with two or more cavities in the forward portion of the body, a camera unit for capturing images and/or video film during pigging of a pipeline being arranged in each cavity. With such a configuration of the pipeline pig, the camera in each camera unit need only cover a part of the inner wall of the pipeline, and it will thus be possible to obtain better and more distinct image and/or video recordings that will more easily detect any damage or other problems in the pipeline.

[0020] The pipeline pig body, as mentioned above, is configured with one or more cavities that are adapted to corresponding camera units which are arranged in their respective cavity. Apart from these cavities, in which camera units are arranged, the pig body has a compact configuration with no internal closed cavities or voids. This makes it easy to produce the pipeline pig and it gives the pig a regular rigidity, enabling it to exert a constant pressure on the inner wall of the pipeline during pigging.

[0021] A non-limiting practical embodiment of the present invention will be described in more detail below, with reference to the attached figures, wherein:

Figure 1 shows an embodiment of the pipeline pig with a camera unit.

Figure 2 shows an embodiment of the pipeline pig with a transmitter for wireless signals and a positioning means.

Figure 3 shows an embodiment of the pipeline pig with two camera units.

[0022] Figures 1-3 show a pipeline pig 10 as the pig is being run through a pipeline 12 with the aid of a pressurised fluid as indicated by the arrows F. The pressurised fluid exerts a force on the pipeline pig that drives it through the pipeline 12.

[0023] The pipeline pig 10 comprises a body 15 which has a forward end portion 16, a rear end portion 17 and a central portion 18 that extends from the forward end portion 16 to the rear end portion 18 such that the body 15 preferably forms a continuous whole.

[0024] The body 15 is preferably made of a soft and flexible material such as a two-component foam material as, for instance, polyurethane, so as to enable the pipeline pig 10 to pass through a bend in the pipeline 12 as shown in the figures, and to a certain extent be adapted to small variations in the internal diameter of the pipeline 12. Inasmuch as the central portion of the body is configured with an external diameter that is slightly larger than the internal diameter of the pipeline, the flexible nature of the body will make it possible to introduce the pipeline pig into the pipeline 12 whilst the central portion 18 presses against the inner wall 13 of the pipeline. A good cleaning effect is thus obtained when the pipeline pig 10 is pushed through the pipeline 12.

[0025] The body 15 is further preferably provided with at least one cavity that projects into the body in the forward end portion 16 thereof, i.e., at the opposite end of the pipeline pig 10 in relation to the end where the pressurised fluid presses on the pig. In the cavity there is arranged a camera unit 21. The camera unit 21 is preferably fixedly secured in the cavity, for example, by means of adhesive or the like. The camera unit 21 can also be moulded into the body 15 during the manufacture thereof. Alternatively, the camera unit 21 can be detachably secured in the body cavity.

[0026] The camera unit 21 comprises at least one camera 22 with a lens 23. The camera lens 23, as shown in the figures, projects out from the forward portion of the body such that the camera can continuously take video film and/or still images of the inner wall 13 of the pipeline.

[0027] The camera is preferably digital and therefore comprises an image sensor (not shown in the figures) which records video film and images. The camera unit 21 further preferably comprises a storage unit 24 that is signally connected to the image sensor such that video film and/or images taken by the camera 22 are stored in the storage unit 24. The storage unit 24 can be a standard memory chip that is in general use today.

[0028] As indicated in Figure 2, the pipeline pig 10, if so desired, can be provided with a transmitter 26 for wireless transfer of data to an external unit, for example, Wi-Fi or Bluetooth. The external unit can typically be a computer, such that when the pipeline pig 10 has been run through a pipeline, video and/or image data that has been captured and stored on the image sensor as the pipeline pig was run through the pipeline can easily be transmitted wirelessly to the computer. If it is practically possible, i.e., that the signals from the transmitter 26 are sufficiently strong, the signals can also be continuously transmitted wirelessly from the pipeline pig 10 to an external unit, such as a computer, whilst the pipeline pig 10 is being run through the pipeline 12.

[0029] The pipeline pig 10 may also be provided with a positioning device 28 as indicated in Figure 2. This can, for example, be a GPS. With a positioning device, it will be possible to know where in the pipeline 12 the pig has been at a given time. If, afterwards, defects in the pipeline are discovered on the video film and/or images taken during the pigging operation, it will be possible to compare with the time when the video film or image was taken and thus find the point in the pipeline that must be examined more closely or repaired.

[0030] Figure 3 shows an embodiment of the pipeline pig 10 where the body 15 is configured with two cavities, and where two camera units 21 are arranged in their respective cavity in the body 15. With two cameras, it will be possible to arrange each camera unit 21 closer to the inner wall 13 of the pipeline and direct the camera more towards the inner wall 13 of the pipeline. This means that video film and/or images of better quality are obtained and it is more likely that any damage to the pipeline 12 will be visible. In Figure 3, the pipeline pig 10 is shown provided with two camera units 21, but it is of course also possible to arranged three or more camera units 21 in the body 15.

[0031] Apart from the fact that the pipeline pig 10 shown in Figure 3 is provided with two camera units 21, the pig 10 in Figure 3 is identical to that shown in Figure 1. The features of the pipeline pig 10 that are identical and that have been explained above will not be repeated here.

[0032] It should be mentioned, too, that an embodiment of the pipeline pig 10 that is provided with two or more camera unit 21, as indicated in Figure 3, can also be provided with a transmitter 26 for wireless communication including a transfer of data to an external unit as explained above in connection with the embodiment of the pipeline pig 10 shown in Figure 2. It will normally be sufficient to include one such transmitter 26 arranged in one of the cavities in the body 15, preferably, but not necessarily, incorporated in the camera unit 21 that is arranged in the cavity. The pipeline pig 10 can of course also be equipped with two or more transmitters, if so desired.

[0033] Similarly, an embodiment of the pipeline pig 10 that is provided with two or more camera units 21 as shown in Figure 3, can also be provided with a positioning device 28 as explained above in connection with the embodiment of the pipeline pig 10 shown in Figure 2. As mentioned, this can, for example, be a GPS. It will normally be sufficient to include one such positioning device 28 in the pipeline pig 10, arranged in one of the cavities in the body 15 and preferably, but not necessarily, incorporated in the camera unit 21 that is arranged in the cavity. The pipeline pig 10 can of course also be equipped with two or more positioning devices if so desired.

[0034] As shown in the figures, the pipeline pig body 15 is preferably provided with a helical groove 19 extending at least once, but preferably several times, around the exterior of the body from the rear end portion 17 to the forward end portion 16. During pigging of a pipeline, a small portion of the pressurised fluid that drives the pipeline pig through the pipeline will thus flow through the groove and impart rotation to the pipeline pig as it is run through the pipeline 10. This combined rotary movement and axial displacement of the pipeline pig as the pig is pushed through the pipeline by the pressurised fluid will contribute to a better cleaning of the inner wall 13 of the pipeline.

[0035] With the exception of the cavity or cavities in the body 15 in which the camera unit or units 21 are placed, the body 15 is preferably solid, i.e., that it is compact and that there are no additional voids in the body 15. This means that the pipeline pig is robust and applies an even pressure against the inner wall 13 of the pipeline. Since the pipeline pig is driven by a pressurised fluid through the pipeline 12, it will also not be connected to cables, hoses, pipes or other physical devices when driven through the pipeline 12 by the pressurised fluid. The pipeline pig is therefore easy to handle and use, and does not require any extra equipment at the location in which it is to be used. The pipeline pig 10 can quite easily be introduced into and run through the pipeline 12 and then removed from the pipeline 12 and taken to a suitable place where data can be transferred to a computer for examination of video and/or image material that has been captured during the pigging operation. As the pipeline pig 10 is independent of external connecting means such as hoses, cable and/or other means when it is driven through the pipeline 12, it will also be capable of being driven over longer distances through the pipeline 12.

[0036] It should be stressed that the illustrated embodiments must be regarded as examples of how the present invention can be implemented without this being considered to be limiting beyond the limitations given by the claims.

Claims

1. A pipeline pig (10) for inspection and cleaning of an inner wall (13) of a pipeline (12), which pipeline pig comprises an elongate body (15) having a forward end portion (16) and a rear end portion (17) in relation to the direction of travel of the pipeline pig during pigging of a pipeline (12), and a central portion (18) which, during pigging of a pipeline (12), is adapted to clean the inner wall (13) of the pipeline; which pipeline pig (10) is provided with at least one camera unit (21) such that the camera unit, during pigging of a pipeline (12), can take images and/or video film of the inner wall (13) of the pipeline; which pipeline pig (10), during pigging of a pipeline (12), is independent of external connecting means such as hoses, cables and/or other means.

2. A pipeline pig according to claim 1, **characterised i n** that the body (15) is configured with at least one cavity extending inside the body (15) from the forward end portion (16) of the body, in which cavity the camera unit (21) is arranged such that the camera unit, during pigging of a pipeline (12), can take images and/or video film of the inner wall (13) of the pipeline.

3. A pipeline pig according to one of claims 1-2, **characterised i n** that the central portion (18) of the body (15) has an external diameter that is as large as or larger than the internal diameter of the pipeline (12).

4. A pipeline pig according to one of claims 1-3, **characterised i n** that the central portion (18) of the body extends from the forward (16) end portion of the body to the rear end portion (17) thereof.

5. A pipeline pig according to one of claims 1-4, **characterised in that** the body (15) is made of a flexible material such as a flexible plastic or rubber material.

6. A pipeline pig according to one of claims 1-5, **characterised i n** that the pipeline pig body (15) is provided with a helical groove (19) formed in the outer surface of body and extending from the rear portion (17) of the body to the forward end portion (16) thereof.

7. A pipeline pig according to one of claims 1-6, **characterised i n** that the camera unit (21) comprises a camera (22) and a memory unit (24) for storing images and/or video film taken by the camera.

8. A pipeline pig according to one of claims 1-7, **characterised i n** that the camera unit (21) comprises a transmitter (26) for wireless transfer of images and/or video film taken by the camera (22) to a receiver unit external to the pipeline pig (10).

9. A pipeline pig according to one of claims 1-8, **characterised i n** that the pipeline pig comprises a positioning means (28) for determining the position of the pig (10) in a pipeline (12) during pigging of the pipeline.

10. A pipeline pig according to claim 9, **characterised i n** that the positioning means (28) is arranged in the cavity of the body (15), and preferably is incorporated in the camera unit (21).

11. A pipeline pig according to one of claims 2-10, **characterised i n** that the pipeline pig (10) is pro-

vided with two or more camera units (21) for taking images and/or video film during pigging of a pipeline (12), which camera units (21) are arranged in the same cavity or in separate cavities in the body (15).

12. A pipeline pig according to one of claims 1-12, **characterised i n** that the at least one camera unit (21) is moulded into the body (15).

13. A pipeline pig according to one of claims 2-11, **characterised i n** that the camera unit or units (21) are permanently secured in the cavity or cavities in the body (15).

14. A pipeline pig according to one of claims 2-11, **characterised i n** that the camera unit or units (21) and/or the memory unit or units (24) are detachably arranged in the cavity or cavities in the body (15).

15. A pipeline pig according to one of claims 1-14, **characterised i n** that the rear (17) end portion and that the pipeline pig body (15) has a compact configuration without internal, closed voids.

16. A pipeline pig according to one of claims 1-15, **characterised i n** that the pipeline pig (10), during pigging of a pipeline (12) is adapted to be driven through the pipeline by a pressurised fluid that presses on the rear end portion (17) of the pipeline pig.

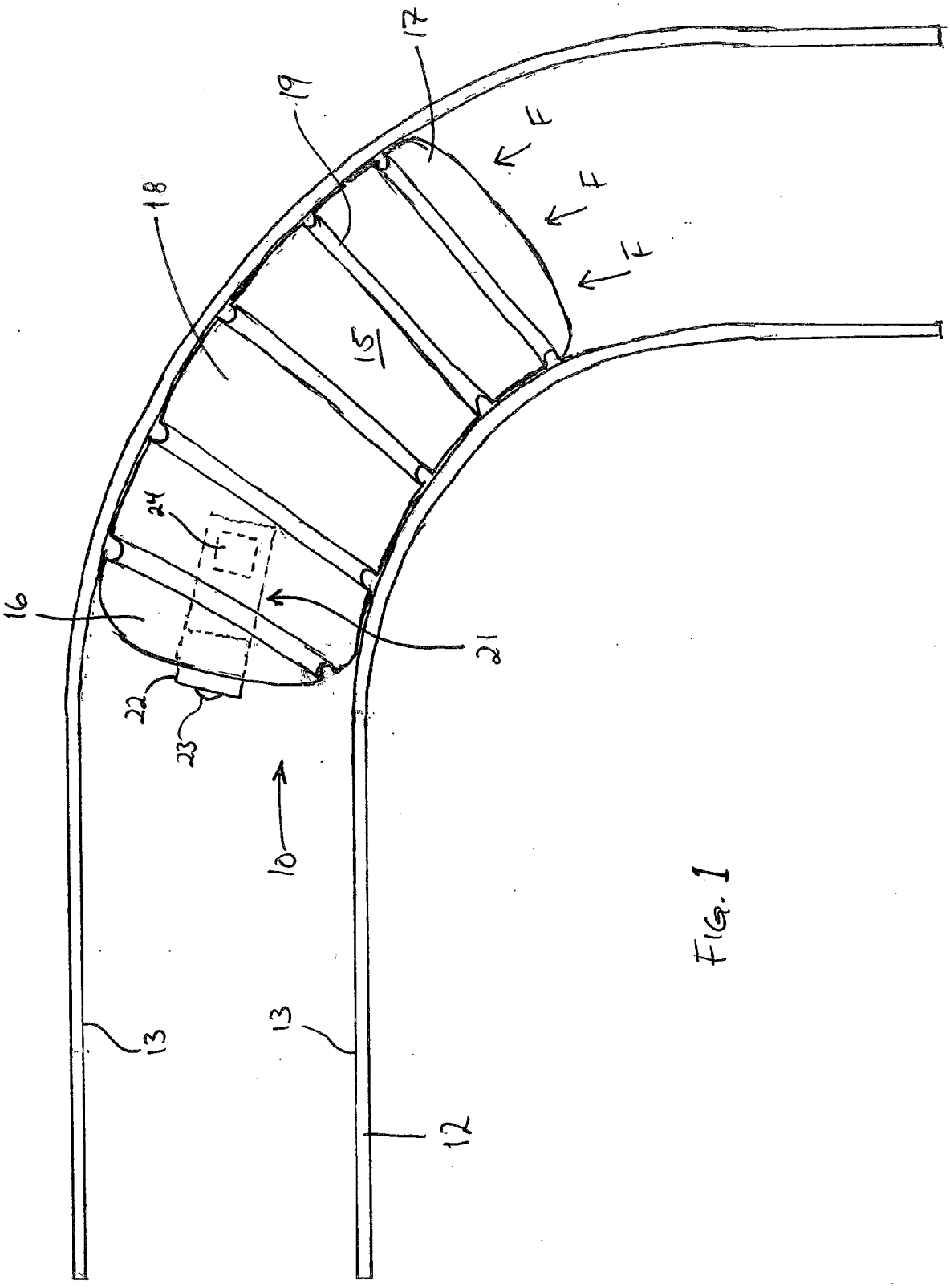

FIG. 1

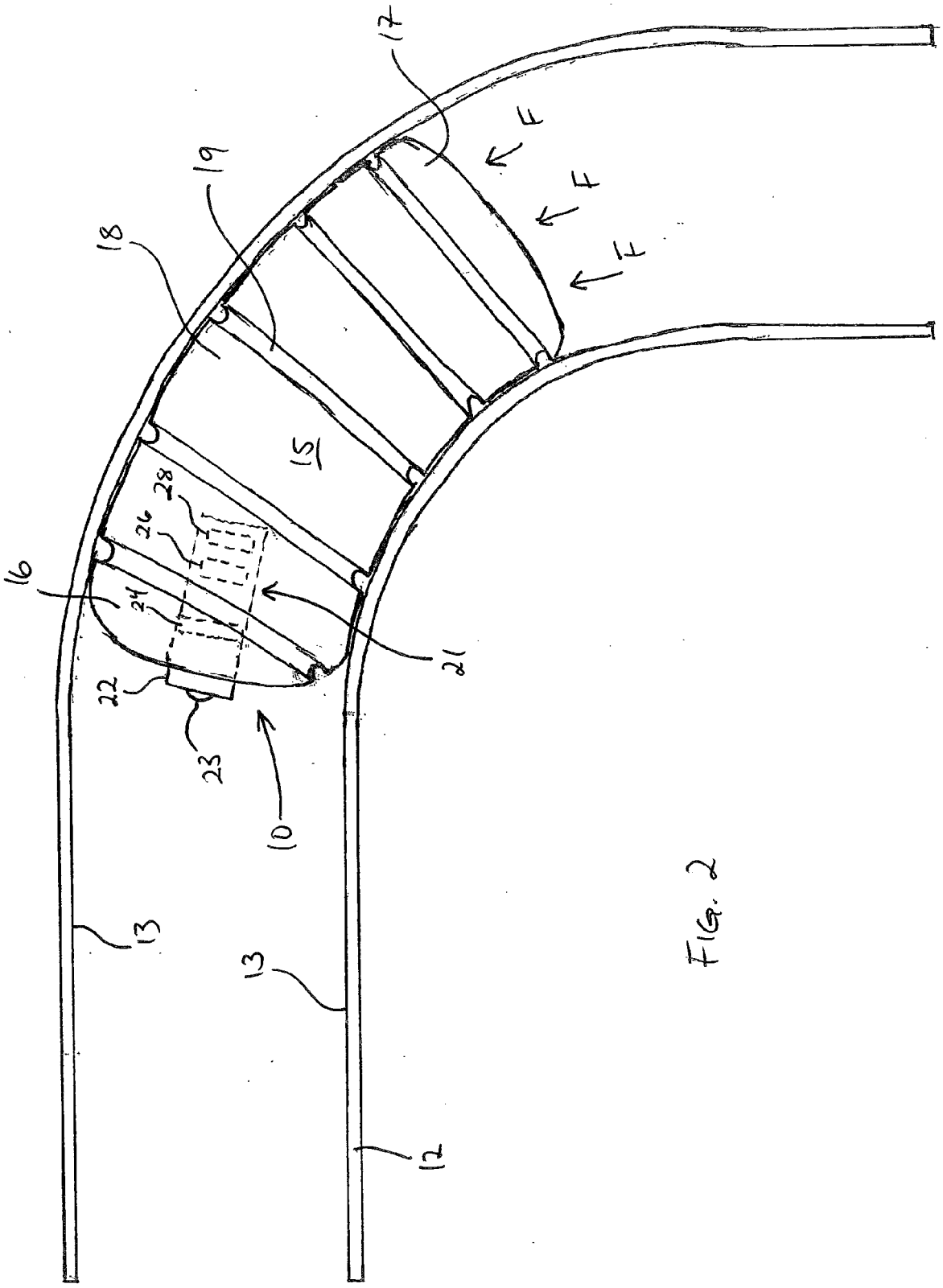

FIG. 2

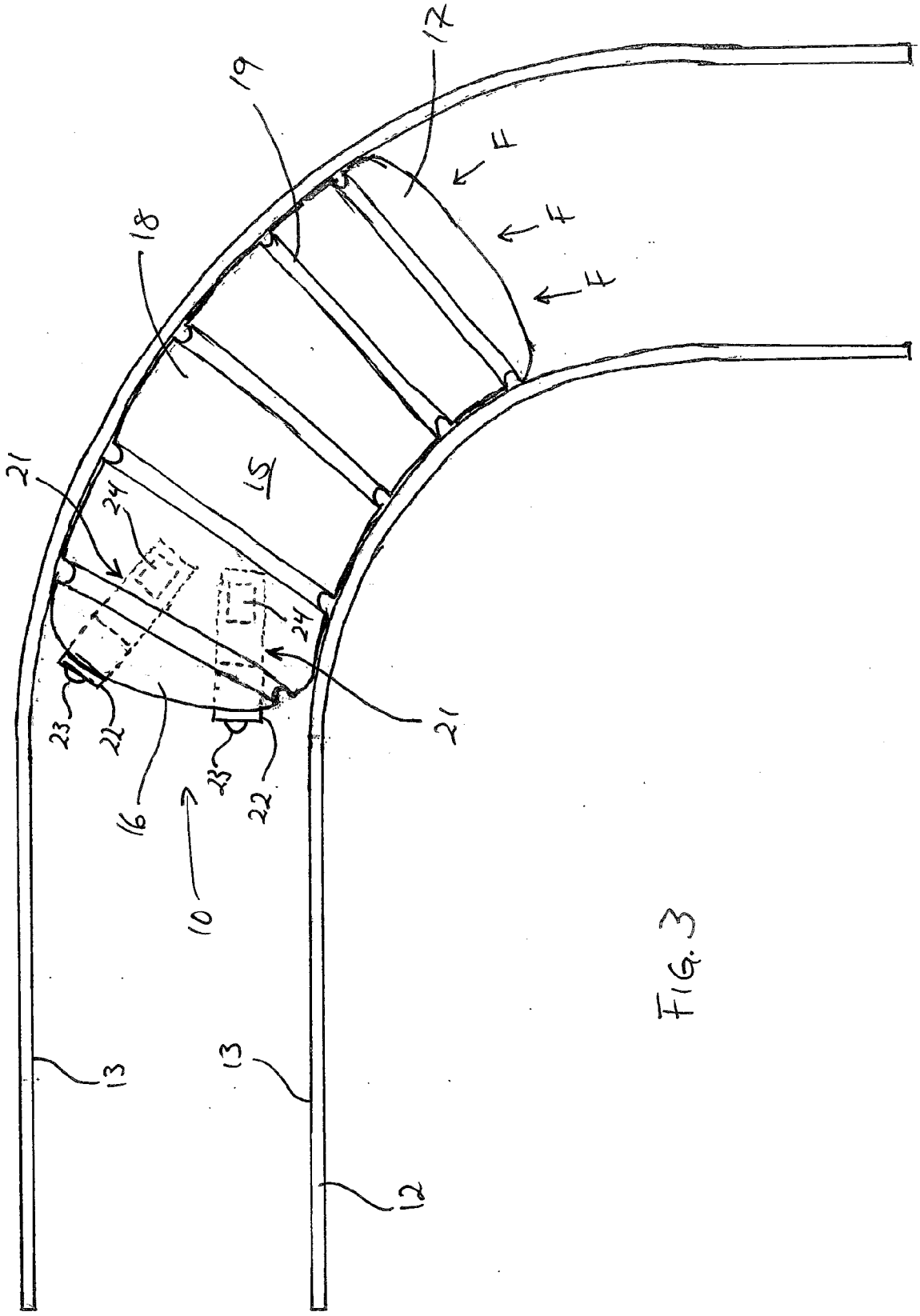

FIG. 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 14 19 0258

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 Y	JP 2000 310389 A (YUSHIN SEIKI KOGYO KK; FURUKAWA KIMINORI) 7 November 2000 (2000-11-07) * abstract; figures * -----	1-5,7,8, 11-16 6	INV. B08B9/055
X A	EP 2 159 574 A2 (ROENTGEN TECH DIENST BV [NL]) 3 March 2010 (2010-03-03) * abstract; figures * * paragraph [0014] - paragraph [0015] * * paragraph [0032] * -----	1-5,7-16 6	
Y	WO 2005/007308 A1 (JEMNE ROLF G [NO]) 27 January 2005 (2005-01-27) * abstract *; figures * * page 3, paragraph 5 - page 4, paragraph 1 * * page 5, paragraph 3 * -----	6	
			TECHNICAL FIELDS SEARCHED (IPC) B08B F16L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	11 March 2015	Plontz, Nicolas

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 14 19 0258

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.

11-03-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2000310389 A	07-11-2000	NONE	
EP 2159574 A2	03-03-2010	AT 526578 T	15-10-2011
		EP 2159574 A2	03-03-2010
WO 2005007308 A1	27-01-2005	NO 320030 B1	10-10-2005
		WO 2005007308 A1	27-01-2005

EPO FORM P0459

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