

(51) International Patent Classification:
B60C 23/00 (2006.01)(21) International Application Number:
PCT/EP2011/073355(22) International Filing Date:
20 December 2011 (20.12.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
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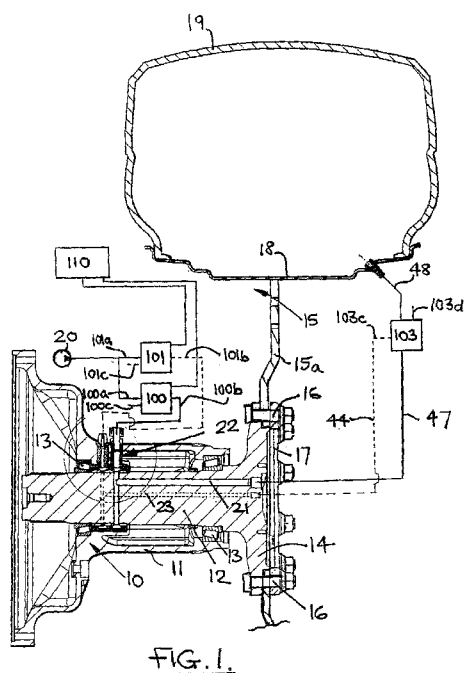
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: TYRE INFLATION



(57) Abstract: A tyre inflation feed arrangement for a tyre (19) supported on a wheel (15) carried by a wheel rim (18) rotatably mounted via a wheel hub (14) on an axially outer end of an axle (12) rotatable within an axle housing (11). The feed arrangement has a first axle passage (21) extending axially within the axle from a first outlet in the wheel hub to a first annular axle zone (12a) on the outer periphery of the axle and a second axle passage (23) extending axially within the axle from a second outlet in the wheel hub to a second annular axle zone (12b) on the outer periphery of the axle. A first radial feed passage (24) extends through the axle housing to supply pressurised air to the first annular axle zone (12a) and a second radial feed passage (27) extends through the axle housing to supply pressurised air to the second annular axle zone (12b). A first sealing means (31) is carried by the housing or axle for co-operating with contact means (30) carried by the axle or housing to seal the first radial feed passage (24) to the first axial passage (21) and a second sealing means (32) is carried by the housing or axle for co-operating with contact means (30) carried by the axle or housing to seal the second radial feed passage (27) to the second axial passage (23). At least part of one of the first and second radial feed passages is lined by or defined by a tube (25, 28). This tube may extend through its associated sealing means or contact means to hold the sealing means or contact means relative to the housing (11).

TYRE INFLATION

This invention relates to tyre inflation arrangements and in particular to such arrangements used on vehicles such as agricultural tractors or the like.

On such vehicles it is necessary, in order to improve efficiency and safety, to change tyre pressures depending on whether, for example, the tractor is operating in field conditions or on the road. When operating in the field lower pressures are required to reduce ground pressure and compaction and to improve grip whereas on the road higher pressures are required to reduce rolling resistance (to improve economy) and to reduce heat generation (to improve safety).

It is an object of the present invention to provide an improved form of tyre inflation feed arrangement which allows the efficient passage of air into the tyres and the release of air from the tyres when required and which is reliable in operation and economical to operate in terms of the wear of the air sealing arrangements used.

Thus according to the present invention there is provided a tyre inflation feed arrangement for a tyre supported on a wheel carried by a wheel rim rotatably mounted via a wheel flange on an axially outer end of an axle rotatable within an axle housing, the feed arrangement comprising a first passage extending axially within the axle from a first outlet in the wheel hub to a first annular axle zone on the outer periphery of the axle, a first radial feed passage extending through the axle housing to supply pressurised air to the first annular axle zone, first sealing means carried by the housing or axle for co-operating with the axle or housing to seal the first radial feed passage to the first axle passage, at least part of the passages being lined by or defined by a tube.

The first sealing means may cooperate with a contact means carried by the axle or housing.

The first radial feed passage may be defined by or lined by a tube.

At least part of the first axle passage may be lined with a tube.

The tube may extend through the contact means or sealing means to hold the contact means or sealing means relative to the axle.

A second passage may extend axially within the axle from a second outlet in the wheel flange to a second annular axle zone on the outer periphery of the axle, a second radial feed passage extends through the axle housing to supply pressurised air to the second annular axle zone, and second sealing means are carried by the housing or axle for co-operating with the axle or housing or a contact member carried thereby to seal the second radial feed passage to the second axle passage.

At least part of the first and/or second axial axle passage may be lined with a tube which extends through the contact means or sealing means to hold the contact means or sealing means relative to the axle.

Both radial feed passages may be defined by tubes. The entire first axial axle passage is lined with tubes.

The first axial axle passage may have an axially extending portion and a radially extending portion which extend across the axle, a lining tube in the axially extending portion of each passage projecting into a tube lining the radially extending portion of the passage.

Each sealing means may comprise a pair of annular seals between which the pressurised air is introduced by the respective radial feed passage.

Each pair of seals may be designed to only make full sealing contact with the associated axle or housing or contact means carried thereby when the associated radial feed passage is pressurised, the pressurised air forcing the seals into contact with the axle or housing or contact means carried thereby.

Each pair of air seals may be located adjacent an axle seal to prevent the ingress oil and dirt around the axle and into the air flow.

The pairs of seals may be located side by side with the axle seals axially outermost relative to the first and second annular axle zones.

The tube or tubes may be formed from stainless steel or other non-corroding material such as non-ferrous metal (bronze, brass) or plastics. Alternatively, tubes may be provided with non-corroding coatings.

The contact means may be a separate and readily replaceable component. For example, the contact means may be made from stainless steel or coated with PTFE (Polytetrafluoroethylene) or may be nitrogen hardened.

Conveniently the first outlet is connectable with the interior of the tyre via a control valve mounted on the wheel to supply air to the tyre from the first radial supply passage. Similarly the second outlet is connected with the control valve to control the valve to supply air pressure to or exhaust air from the tyre under the control of the air pressure supplied via the second radial supply passage.

The present invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 shows an axial sectional view through half of a tractor rear axle fitted with a tyre inflation feed arrangement in accordance with the present invention;

Figure 2 shows a section through the rear axle of Figure 1 on a larger scale;

Figure 3 shows a section on a larger scale of the area circled at X in Figure 2;

Figure 4 shows an alternative embodiment of the present invention in a section on a larger scale similar to Figure 3, and

Figure 5 shows a further alternative embodiment of the present invention in a section on a larger scale similar to Figure 3.

Referring to the drawings, a tractor rear axle 10, half of which is shown in cross-section in Figure 1 or 3, has an outer trumpet housing 11 within which a driveshaft 12 is supported by bearings 13. Driveshaft 12 terminates in a hub flange 14 to which a wheel disc 15a of a wheel 15 is clamped by bolts 16 and a clamping ring 17.

The wheel disc 15a carries a wheel rim 18 on which a pneumatic tyre 19 is mounted. The present invention is concerned with a tyre inflation feed arrangement 22 for conveying compressed air from a compressor 20 via air control valves 100 and 101

mounted on the tractor to the rotating wheel 15 and hence via an air control valve 103 mounted on the wheel to the interior of the tyre 19 via lines 47 and 48. Control valves 100 and 101 are solenoid control valves which are controlled by a control unit 110. These valves are 3/2 way control valves which open the air flow from intake lines 100a and 101a (connected to the compressor 20) to outlet lines 100b and 101b when activated by solenoid. When valves 100 and 101 are not activated intake lines 100a and 101a, 102a is closed and the outlet lines 100b and 101b are connected to the ambient discharge lines 100c and 101c.

Control valve 103 is a biased pressure controlled valve which opens the air flow from line 47 and thereby compressor 20 to line 48 and the interior of the tyre 19 when the control inlet 103c is charged with air via control line 44. In the non-activated condition of valve 103 line 47 is connected to the ambient discharge line 103d while the line 48 is blocked. Thereby, leakage in line 44, line 47 or the tyre inflation feed arrangement 22 would not cause unintentional deflation of the tyre.

The tyre inflation feed arrangement 22 comprises a first passage 21 in shaft 12 which extends within shaft 12 from hub 14 to a first annular axle zone 12a on the outer periphery of shaft 12 and a second passage 23 which also extends within shaft 12 from hub 14 to a second annular axle zone 12b on the outer periphery of shaft 12. First passage 21 is connected with line 47 and second passage 23 is connected with line 44. A first radial feed passage 24 is provided by a pipe 25 which extends through housing 11 and is provided with a pipe fitting 26 which connects passage 24 to line 100b. A second radial feed passage 27 is provided by a pipe 28 which also extends through housing 11 and is provided with a pipe fitting 29 which connects passage 27 to line 101b. Pipes 25 and 28 can be made from Stainless steel or brass or some other non-corroding material.

A contact means 30 surrounds annular zones 12a and 12b and is sealed to shaft 12 by seals 30a. This contact means is formed from or coated with plastics material such as PTFE or could be made from stainless steel or could be hardened by nitrogen to resist wear. Passages 21 and 23 emerge through contact means 30 in the vicinity of the inner ends of pipes 25 and 28. A first sealing means 31 seals the inner end of pipe 25 to the

contact means 30 and a second sealing means seals the inner end of pipe 28 to this contact means 30.

First sealing means 31 has an outer casing 31a into which pipe 25 is screwed by thread 25a and a pair of seals 31b on either side of pipe 25 which, when pipe 25 is pressurised are forced into sealing contact with the contact member 30 to seal the flow of air from pipe 100b to passage 21. A shaft seal 31c is also provided in casing 31a to prevent the ingress of oil and dirt around axle 12.

Similarly, second sealing means 32 has an outer casing 32a into which pipe 28 is screwed by thread 28a and a pair of seals 32b on either side of pipe 28 which, when pipe 28 is pressurised are forced into sealing contact with the contact member 30 to seal the flow of air from pipe 101b to passage 23. A shaft seal 32c is also provided in casing 31a to prevent the ingress of oil and dirt around axle 12.

The two sealing means 31 and 32 are located side by side with shaft seals 31c and 32c axially outermost relative to the two annular axle zones 12a and 12b. A spacer 33 is located between the sealing means.

Use of a separate contact means 30 allows relatively easy replacement of the contact member if it becomes worn due to the contact pressure of sealing means 31 and 32 without the need for replacement of the expensive wheel flange 14 and associated shaft 12. The fact that the sealing means only make sealing contact with the contact member when their associated feed pipe is pressurised also helps to reduce wear of the contact means.

Although in the embodiment described the seals 31 and 32 are carried by housing 11 and the contact member 30 is mounted on shaft 12, this arrangement could be reversed if desired.

Passage 21 needs to carry a large volume of air to inflate the tyre and such air can be damp. Thus passage 21 in axle 12, which is typically made from cast iron, can be lined with stainless steel tubes 21a and 21b. Tube 21a extending axially within axle 12 and having an end portion 21c which extends into the radially extending tube 21b. By

lining the passage 21 with tubes 21a and 21b corrosion of passage 21 is minimised. Also tube 21b can extend radially through contact means 30 to help locate the contact means relative to the axle. Passage 23 could also be lined with non-corrosive material although this is less important as less volume of air travels through passage 23.

The above described tyre inflation feed arrangement 22 operates as follows.

To increase the air pressure in the tyre 19 control valve 100 is opened so that air from the compressor 20 is supplied to control valve 103 via pipe 25 and passage 21 to supply line 47. At the same time, the control inlet 103c of control valve 103 is charged with air via pipe 28 and passage 23, so that the passage to line 48 and the interior of the tyre 19 is open. Thereby, pressure in the tyre 19 is increased.

If it is desired to release some air pressure from within the tyre the control inlet 103c of control valve 103 is charged with air via control line 44 and pipe 28 so that supply line 47 and control valve 100 are connected to the line 48 and hence the interior of the tyre 19. As at the same time, valve 100 is switched into a position so that the outlet 100b is connected to the ambient discharge 100c, the interior of the tyre is thus connected to the ambient environment so the tyre pressure inside the tyre 19 is decreased.

Tubes 25 or 28 may be integrally formed together with pipe fitting 26 or 29 for cost reasons.

Figure 4 shows an alternative design in which the tubes 25 and 28 are not screwed into the outer casings 31a and 32a, but screwed into outer trumpet housing 11 by threads 11a. The fixation of the outer casings 31a and 32a is thereby ensured by engaging bores 25b and 28b as a press fit.

In the embodiments shown in Figures 3 and 4, tubes 25 and 28 at the same time provide axial and circumferential fixation of the outer casings 31a and 32a, and thereby seals 31 and 32 within outer trumpet housing 11. The circumferential position of the seals 31 and 32 in relation to the connecting contours between outer casings 31a / 32a and tubes 25 and 28 may be shown by external markers which have to be

aligned during assembly. By arrangement no force fitting of the seals 31 and 32 is required and easy assembly is provided.

A further embodiment is shown in Figure 5 which omits axial and radial fixation of the outer casings 31a and 32a by means of tubes 25 and 28, as outer casings 31a and 32a are pressed fit into outer trumpet housing 11. Still, tubes 25 and 28 are screwed into outer trumpet housing 11 by threads 11a, but do not contact outer casings 31a and 32a. To provide a closed cavity, for corrosive protection, sealing means 33a and 33b connect outer casings 31a and 32a and tubes 25 and 28. Note that in the Figure 5 arrangement, the tubes line the passages 24 and 27 which are completely encircled by parts of the housing 11.

The use of tubes 25 and 28 to define the feed passages 24 and 27 reduces corrosion and in addition the tubes 25 and 28 locate the seals within the housing. Thereby the manufacturing costs for the housing are reduced and the use of cartridge type seals in casings 31a and 32a also greatly simplifies seal installation.

CLAIMS

1. A tyre inflation feed arrangement for a tyre supported on a wheel carried by a wheel rim rotatably mounted via a wheel flange on an axially outer end of an axle rotatable within an axle housing, the feed arrangement comprising a first passage extending axially within the axle from a first outlet in the wheel flange to a first annular axle zone on the outer periphery of the axle, a first radial feed passage extending through the axle housing to supply pressurised air to the first annular axle zone, first sealing means carried by the housing or axle for co-operating with the axle or housing to seal the first radial feed passage to the first axle passage, at least part of the passages being lined by or defined by a tube.
2. A feed arrangement according to claim 1 in which the first sealing means cooperates with a contact means carried by the axle or housing.
3. A feed arrangement according to claim 1 or 2 in which the first radial feed passage is defined by or lined by a tube.
4. A feed arrangement according to claim 1 or claim 2 in which at least part of the first axle passage is lined with a tube.
5. A feed arrangement according to any one of claims 2 to 4 in which the tube extends through the contact means or sealing means to hold the contact means or sealing means relative to the axle.
6. A feed arrangement according to any one of claims 1 to 5 in which a second passage extends axially within the axle from a second outlet in the wheel flange to a second annular axle zone on the outer periphery of the axle, a second radial feed passage extends through the axle housing to supply pressurised air to the second annular axle zone, and second sealing means are carried by the housing or axle for co-operating with the axle or housing or a contact member carried thereby to seal the second radial feed passage to the second axle passage.
7. A feed arrangement according to claim 6 in which both radial feed passages are defined by tubes.

8. A feed arrangement according to any one of claims 1 to 7 in which the entire first axial axle passage is lined with tubes.
9. A feed arrangement according to claim 8 in which the first axial axle passage has an axially extending portion and a radially extending portion which extends across the axle, a lining tube in the axially extending portion of each passage projecting into a tube lining the radially extending portion of the passage.
10. A feed arrangement according to any one of claims 1 to 6 in which each sealing means comprises a pair of annular seals between which the pressurised air is introduced by the respective radial feed passage.
11. A feed arrangement according to claim 10 in which each pair of seals is designed to only make full sealing contact with the associated axle or housing or contact means carried thereby when the associated radial feed passage is pressurised, the pressurised air forcing the seals into contact with the axle or housing or contact means carried thereby.
12. A feed arrangement according to claim 10 or 11 in which each pair of air seals are located adjacent an axle seal to prevent the ingress oil and dirt around the axle and into the air flow.
13. A feed arrangement according to claim 12 in which the pairs of seals are located side by side with the axle seals axially outermost relative to the first and second annular axle zones.
14. A feed arrangement according to any one of claims 1 to 8 in which the tube or tubes are formed from stainless steel or other non-corroding material.
15. A feed arrangement according to any one of claims 2 to 14 in which the contact means is a separate and readily replaceable component.
16. A feed arrangement according to claim 15 in which the contact means is made from stainless steel or is coated with PTFE or is nitrogen hardened.

17. A feed arrangement according to any one of claims 1 to 16 in which the first outlet is connectable with the interior of the tyre via a control valve mounted on the wheel to supply air to the tyre from the first radial supply passage.
18. A feed arrangement according to claim 17 in which the second outlet is connected with the control valve to control the valve to supply air pressure to or exhaust air from the tyre under the control of the air pressure supplied via the second radial supply passage.
19. A tyre inflation feed arrangement constructed and arranged substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

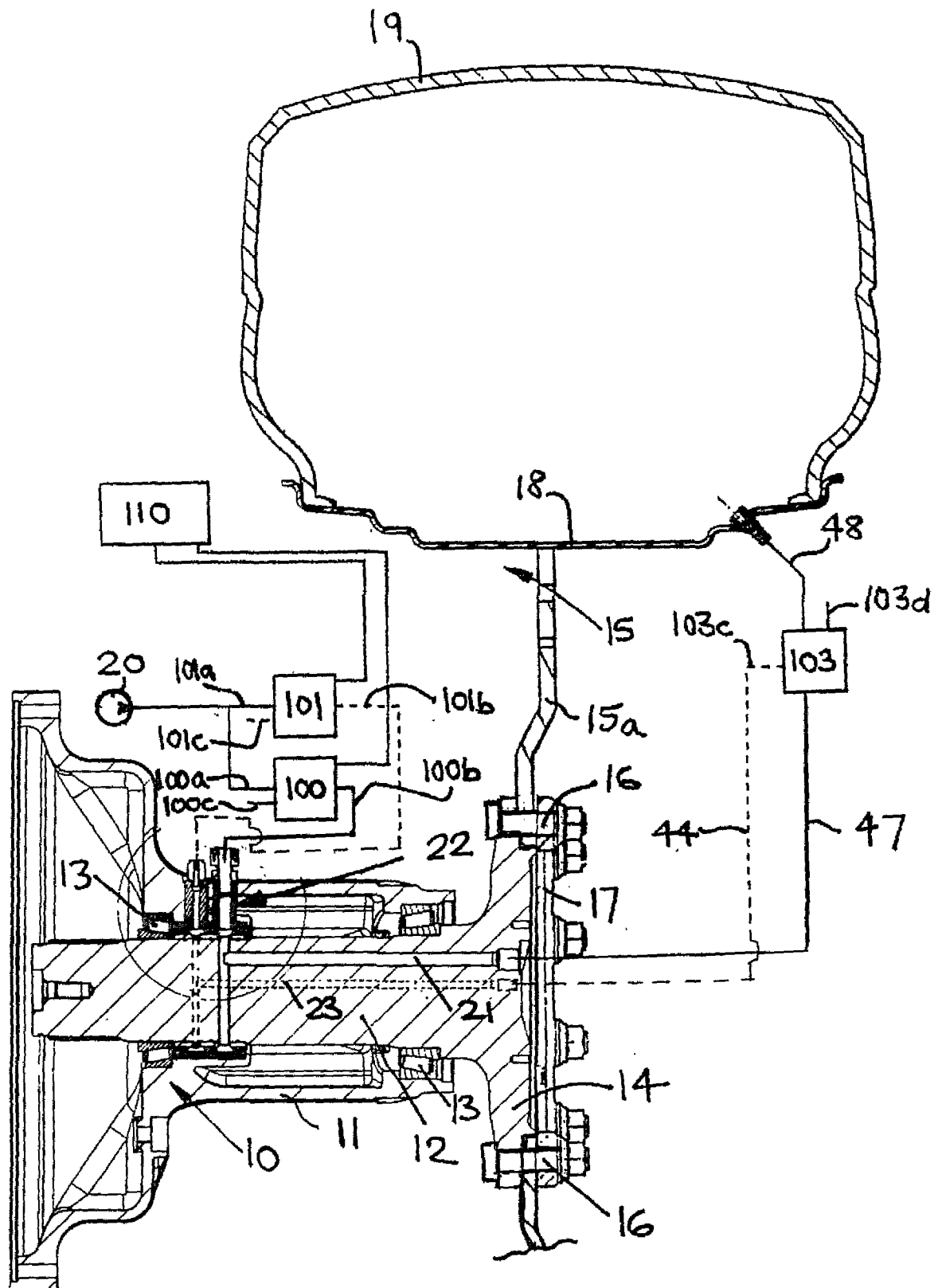


FIG. 1.

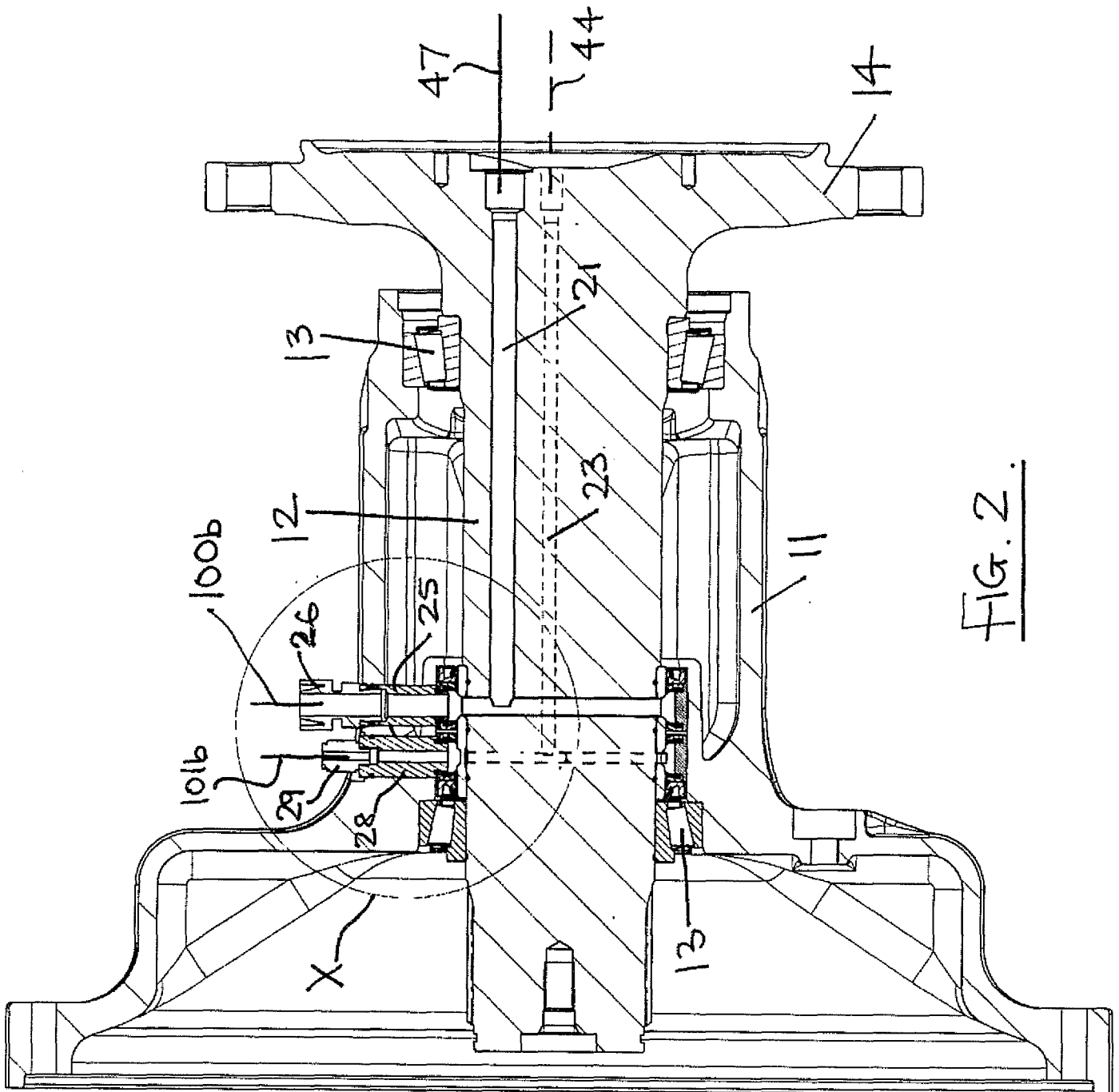
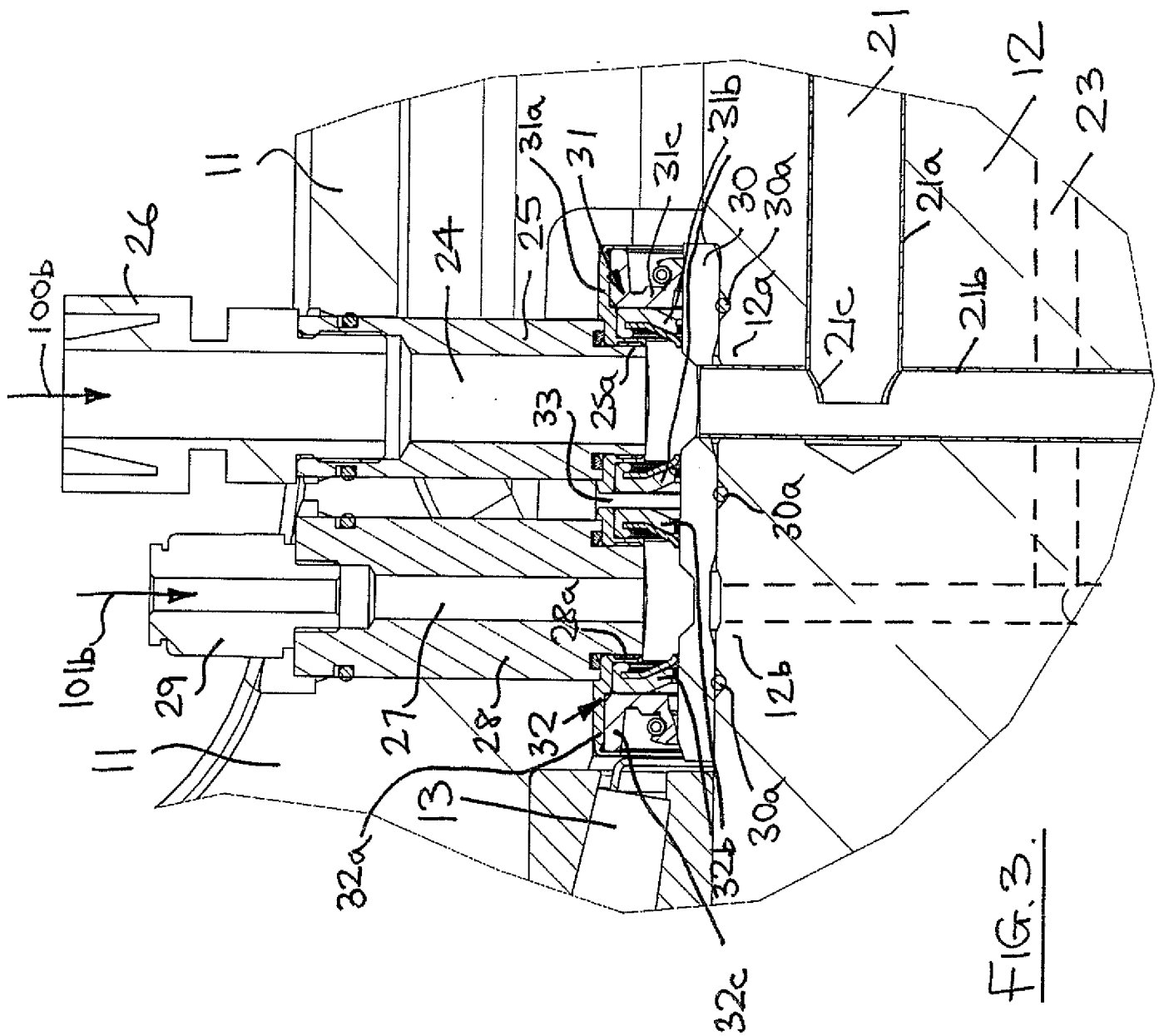
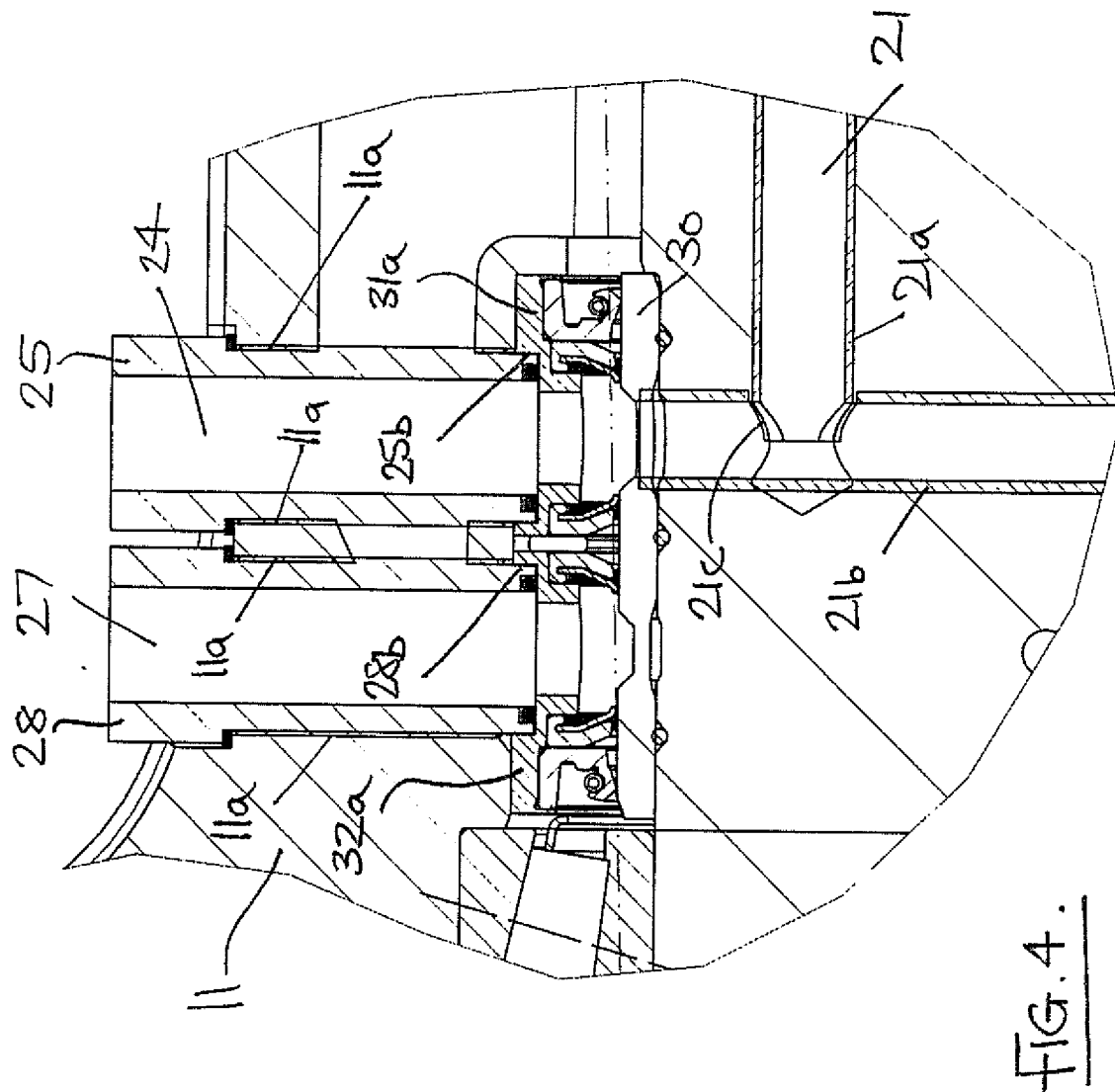


Fig. 2.





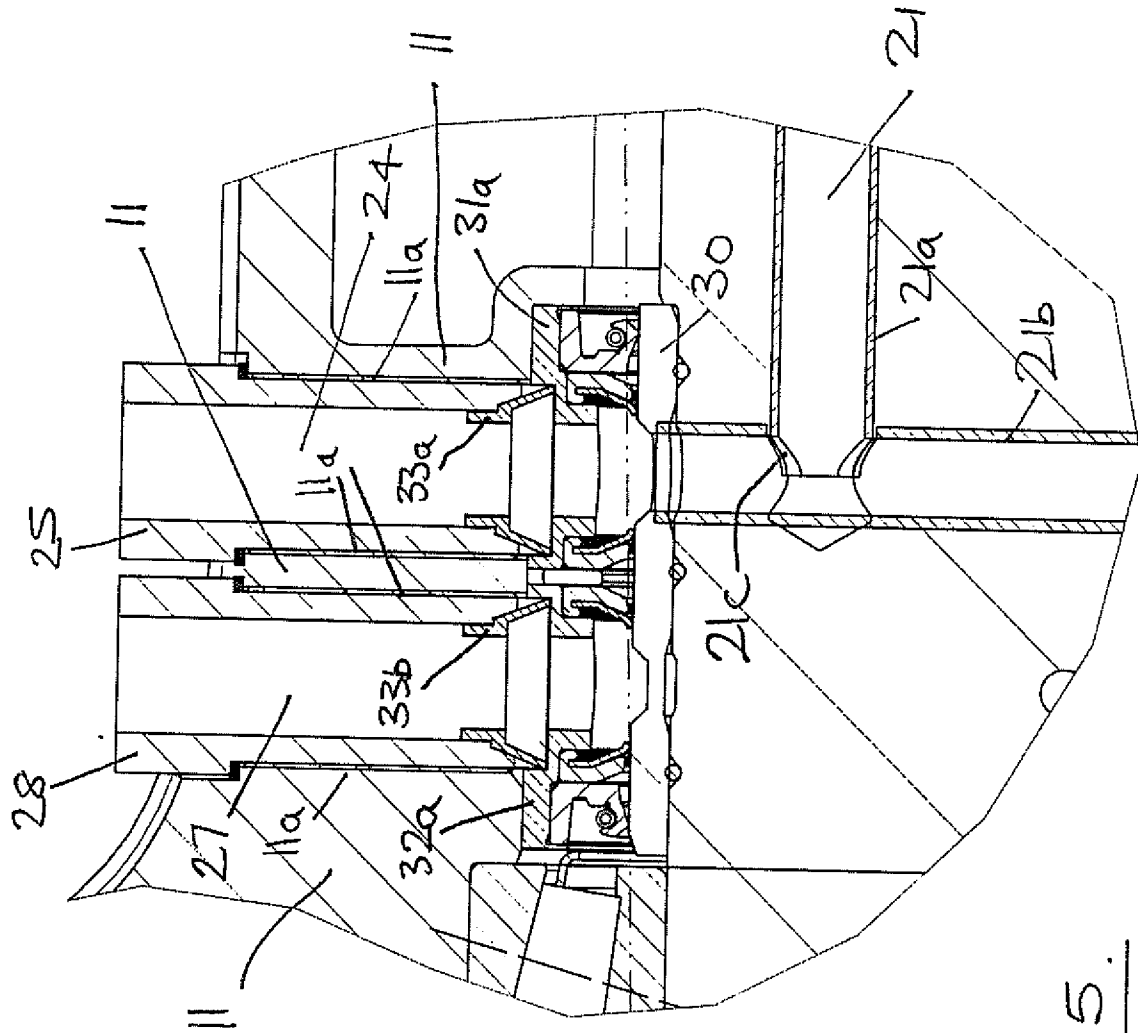


FIG. 5.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2011/073355

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 19
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2011/073355

A. CLASSIFICATION OF SUBJECT MATTER
 INV. B60C23/00
 ADD.

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)
 B60C

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 457 028 A2 (STECH CLYDE GILBERT [US] EQUALAIRE SYSTEMS INC [US]) 21 November 1991 (1991-11-21)	1-5,10, 14-17
Y	figure 5	6-8, 11-13,18
Y	----- US 2009/084481 A1 (KALAVITZ MICHAEL V [US]) 2 April 2009 (2009-04-02) figures 4,5	6,11-13, 18
X	----- FR 2 373 404 A1 (VERDY ROBERT [FR]) 7 July 1978 (1978-07-07)	9
Y	page 3, line 8 - line 11; figure 2 -----	7,8



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

27 March 2012

Date of mailing of the international search report

05/04/2012

Name and mailing address of the ISA/

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Schork, Willi

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2011/073355

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0457028	A2	21-11-1991	AT 131781 T 15-01-1996
		CA 2042478 A1 18-11-1991	
		DE 69115557 D1 01-02-1996	
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		EP 0457028 A2 21-11-1991	
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		JP 4231203 A 20-08-1992	
		MX 173120 B 01-02-1994	

US 2009084481	A1	02-04-2009	NONE

FR 2373404	A1	07-07-1978	NONE

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 19

Claim 19 contravenes Rule 6.2(a) PCT. Furthermore, lacking technical features, the subject-matter of claim 19 is unclear (Article 6 PCT). As a consequence, the subject-matter of claim 19 was exempted from search.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.