



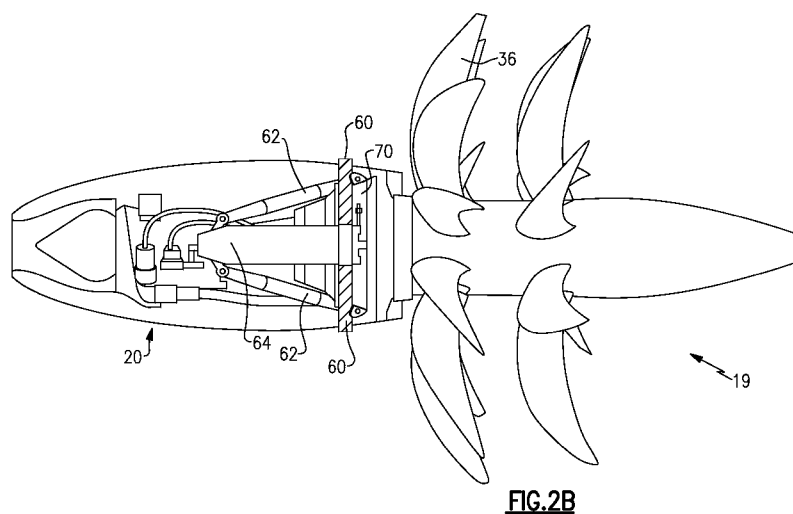
- (51) International Patent Classification:
F02C 7/36 (2006.01) *F02C 7/32* (2006.01)
- (21) International Application Number:
PCT/US2013/044022
- (22) International Filing Date:
4 June 2013 (04.06.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/751,027 10 January 2013 (10.01.2013) US
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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, BN, 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, 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, PA, 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, 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, KM, ML, MR, NE, SN, TD, TG).

Published:

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

(54) Title: TWO SPOOL GAS GENERATOR WITH MOUNT RING



(57) Abstract: A gas turbine engine has a first shaft including a first turbine rotor, and a second shaft including a second turbine rotor disposed downstream of the first turbine rotor. A third shaft includes a propulsor turbine positioned downstream of the second turbine rotor for driving a propeller. A mount ring is secured between the second turbine rotor and the propeller.



TWO SPOOL GAS GENERATOR WITH MOUNT RING

BACKGROUND

[0001] This application relates to a two spool gas generator for a gas turbine engine and a propulsor drive.

[0002] Conventional gas turbine engines typically include a fan section, a compressor section and a turbine section. There are two general known architectures. In one architecture, a low speed spool includes a low pressure turbine driving a low pressure compressor and also driving a fan. A gear reduction may be placed between the spool and the fan in some applications. There are also direct drive engines.

[0003] Another known architecture includes a third spool with a third turbine being positioned downstream of the low pressure turbine and driving the fan. The three spools have shafts connecting a turbine to the driven element, and the three shafts are mounted about each other.

[0004] All of these architectures raise challenges.

SUMMARY

[0005] In a featured embodiment, a gas turbine engine has a first shaft including a first turbine rotor, and a second shaft including a second turbine rotor disposed downstream of the first turbine rotor. A third shaft includes a propulsor turbine positioned downstream of the second turbine rotor for driving a propeller. A mount ring is secured between the second turbine rotor and the propeller.

[0006] In another embodiment according to the previous embodiment, a turbine case is positioned intermediate the second turbine rotor and the propeller. The mount ring is secured to an outer surface of the turbine case.

[0007] In another embodiment according to any of the previous embodiments, the propulsor turbine is mounted within the turbine case.

[0008] In another embodiment according to any of the previous embodiments, the mount ring is provided with a mount plate.

[0009] In another embodiment according to any of the previous embodiments, the mount plate is connected to the mount ring by a plurality of pivotally connected links.

[0010] In another embodiment according to any of the previous embodiments, two of the links are positioned on opposed circumferential sides of the mount plate.

[0011] In another embodiment according to any of the previous embodiments, the mount plate is pivotally attached to the mount ring.

[0012] In another embodiment according to any of the previous embodiments, a torque link is pivotally connected to the mount plate and to the mount ring.

[0013] In another embodiment according to any of the previous embodiments, the first turbine rotor drives a first compressor rotor through the first shaft, and the second turbine rotor drives a second compressor rotor through the second shaft.

[0014] In another embodiment according to any of the previous embodiments, the second compressor rotor has a first overall pressure ratio. The first compressor rotor has a second overall pressure ratio, with the ratio of the first overall pressure ratio to the second overall pressure ratio being greater than or equal to about 2.0.

[0015] In another embodiment according to any of the previous embodiments, the ratio of the first overall pressure ratio to the second overall pressure ratio is greater than or equal to about 3.0.

[0016] In another embodiment according to any of the previous embodiments, the ratio of the first overall pressure ratio to the second overall pressure ratio is less than or equal to about 8.0.

[0017] In another embodiment according to any of the previous embodiments, the first turbine rotor includes a single turbine stage.

[0018] In another embodiment according to any of the previous embodiments, the second turbine rotor includes two stages.

[0019] In another embodiment according to any of the previous embodiments, the second compressor rotor includes eight stages.

[0020] In another embodiment according to any of the previous embodiments, the first compressor rotor includes six stages.

[0021] In another embodiment according to any of the previous embodiments, the first compressor rotor includes six stages.

[0022] In another embodiment according to any of the previous embodiments, wherein said second compressor rotor includes eight stages.

[0023] These and other features may be best understood from the following drawings and specification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] Figure 1 schematically shows a three spool gas turbine engine.

[0025] Figure 2A schematically shows an engine.

[0026] Figure 2B shows an engine mount structure.

[0027] Figure 3 shows details of the engine mount.

DETAILED DESCRIPTION

[0028] A gas turbine engine 19 is schematically illustrated in Figure 1. A core engine, or gas generator 20, includes high speed shaft 21 is part of a high speed spool along with a high pressure turbine rotor 28 and a high pressure compressor rotor 26. A combustion section 24 is positioned intermediate the high pressure compressor rotor 26 and the high pressure turbine rotor 28. A shaft 22 of a low pressure spool connects a low pressure compressor rotor 30 to a low pressure turbine rotor 32.

[0029] Engine 19 also includes a free turbine 34 is shown positioned downstream of the low pressure turbine rotor 32 and serves to drive a propeller 36.

[0030] Various embodiments are within the scope of the disclosed engine. These include embodiments in which:

[0031] a good deal more work is done by the low pressure compressor rotor 30 than by the high pressure compressor rotor 26;

[0032] the combination of the low pressure compressor rotor 30 and high pressure compressor rotor 26 provides an overall pressure ratio equal to or above about 30;

[0033] the low pressure compressor rotor 30 includes eight stages and has a pressure ratio at cruise conditions of 14.5; in this embodiment, the high pressure compressor rotor 26 had six stages and an overall pressure ratio of 3.6 at cruise;

[0034] a ratio of the low pressure compressor pressure ratio to the high pressure compressor ratio is greater than or equal to about 2.0, and less than or equal to about 8.0;

[0035] more narrowly, the ratio of the two pressure ratios is between or equal to about 3.0 and less than or equal to about 8; and

[0036] even more narrowly, the ratio of the two pressure ratios is greater than about 3.5.

[0037] In the above embodiments, the high pressure compressor rotor 26 will rotate at slower speeds than in the prior art. If the pressure ratio through the fan and low pressure compressor are not modified, this could result in a somewhat reduced overall pressure ratio. The mechanical requirements for the high pressure spool, in any event, are relaxed.

[0038] With the lower compressor, the high pressure turbine rotor 28 may include a single stage. In addition, the low pressure turbine rotor 32 may include two stages.

[0039] By moving more of the work to the low pressure compressor rotor 30, there is less work being done at the high pressure compressor rotor 26. In addition, the temperature at the exit of the high pressure compressor rotor 26 may be higher than is the case in the prior art, without undue challenges in maintaining the operation.

[0040] Variable vanes are less necessary for the high pressure compressor rotor 26 since it is doing less work. Moreover, the overall core size of the combined compressor rotors 30 and 26 is reduced compared to the prior art.

[0041] The engine 19 has what may be called a propulsor turbine 34 which is axially downstream of the low pressure turbine rotor 32. Further, the high pressure spool radially surrounds the low pressure spool, but neither of the spools surrounds the propulsor turbine, nor the shaft 100 connecting the propulsor turbine to the propeller 36. In this sense, the propulsor rotor is separate from the gas generator portion of the engine.

[0042] The disclosed engine architecture creates a smaller core engine and yields higher overall pressure ratios and, therefore, better fuel consumption. Further, uncoupling the low pressure turbine 32 from driving prop 36 enables it to run at a lower compressor surge margin, which also increases efficiency. Moreover, shaft diameters can be decreased and, in particular, for the diameter of the low pressure shafts as it is no longer necessary to drive the prop 36 through that shaft.

[0043] In the prior art, the ratio of the low pressure compressor pressure ratio to the high pressure compressor ratio was generally closer to .1 to .5. Known three spool engines have a ratio of the low pressure compressor pressure ratio to the high pressure compressor ratio of between .9 and 3.0.

[0044] With the very small diameter core engine 20, there will be challenges in mounting the engine 19 to an aircraft. In particular, if the engine 19 was mounted as in the prior art, at front and rear locations, there would be challenges from so-called “backbone bending” due to the small diameter. Thus, as shown in Figure 2A, a mount ring 60 is secured to a turbine case 70 that is downstream of the core engine 20. The turbine case 70 may also receive the propulsor turbine 34 and the gear reduction 200. The propellers 36 are downstream and beyond the turbine case. The ring 60 supplies the sole mount plane for the engine 19. A plate 64 extends forwardly from the ring and includes a plurality of struts, one of which, 62, is illustrated in Figure 2A. An aircraft body 84 is shown schematically and is secured to the plate 64.

[0045] As shown in Figure 2B, there is a pair of struts 62 extending in opposed lateral directions and pivotally connect between the plate 64 and the ring 60.

[0046] As shown in Figure 3, the plate 64 is secured to aircraft body at 84. The ring 60 has an inner surface 71 that will surround the turbine case 70 and be secured to the turbine case. Pivot point 74 and 75 also secure a torque link between the plate 64 and the ring 60. Both struts 62 are shown pivotally attached at 63 to the plate 64 and pivotally attached at 65 to the ring 60. Further, the plate 64 is itself pivotally attached at 80 to the ring. The ring 60 and plate 64 provide a cantilever mount for the engine 19.

[0047] Although an embodiment of this invention has been disclosed, a worker of ordinary skill in this art would recognize that certain modifications would come within the scope of this disclosure. For that reason, the following claims should be studied to determine the true scope and content of this disclosure.

CLAIMS

1. A gas turbine engine comprising:
 - a first shaft including a first turbine rotor, a second shaft including a second turbine rotor disposed downstream of said first turbine rotor; and
 - a third shaft including a propulsor turbine, positioned downstream of said second turbine rotor, for driving a propeller; and
 - a mount ring secured between said second turbine rotor and said propeller.
2. The gas turbine engine as set forth in claim 1, wherein a turbine case is positioned intermediate said second turbine rotor and said propeller, and said mount ring being secured to an outer surface of said turbine case.
3. The gas turbine engine as set forth in claim 2, wherein said propulsor turbine is mounted within said turbine case.
4. The gas turbine engine as set forth in claim 1, wherein said mount ring is provided with a mount plate.
5. The gas turbine engine as set forth in claim 4, wherein said mount plate is connected to said mount ring by a plurality of pivotally connected links.
6. The gas turbine engine as set forth in claim 5, wherein two of said links are positioned on opposed circumferential sides of said mount plate.
7. The gas turbine engine as set forth in claim 6, wherein said mount plate is pivotally attached to said mount ring.
8. The gas turbine engine as set forth in claim 7, wherein a torque link is pivotally connected to said mount plate and to said mount ring.

9. The gas turbine engine as set forth in claim 1, wherein said first turbine rotor driving a first compressor rotor through said first shaft, and said second turbine rotor driving a second compressor rotor through said second shaft.
10. The gas turbine engine as set forth in claim 9, wherein said second compressor rotor having a first overall pressure ratio, and said first compressor rotor having a second overall pressure ratio, with the ratio of said first overall pressure ratio to said second overall pressure ratio being greater than or equal to about 2.0.
11. The gas turbine engine as set forth in claim 10, wherein said ratio of said first overall pressure ratio to said second overall pressure ratio is greater than or equal to about 3.0.
12. The gas turbine engine as set forth in claim 10, wherein said ratio of said first overall pressure ratio to said second overall pressure ratio being less than or equal to about 8.0.
13. The gas turbine engine as set forth in claim 12, wherein said first turbine rotor includes a single turbine stage.
14. The gas turbine engine as set forth in claim 13, wherein said second turbine rotor includes two stages.
15. The gas turbine engine as set forth in claim 10, wherein said second compressor rotor includes eight stages.
16. The gas turbine engine as set forth in claim 15, wherein said first compressor rotor includes six stages.
17. The gas turbine engine as set forth in claim 1, wherein said first compressor rotor includes six stages.

18. The gas turbine engine as set forth in claim 1, wherein said second compressor rotor includes eight stages.

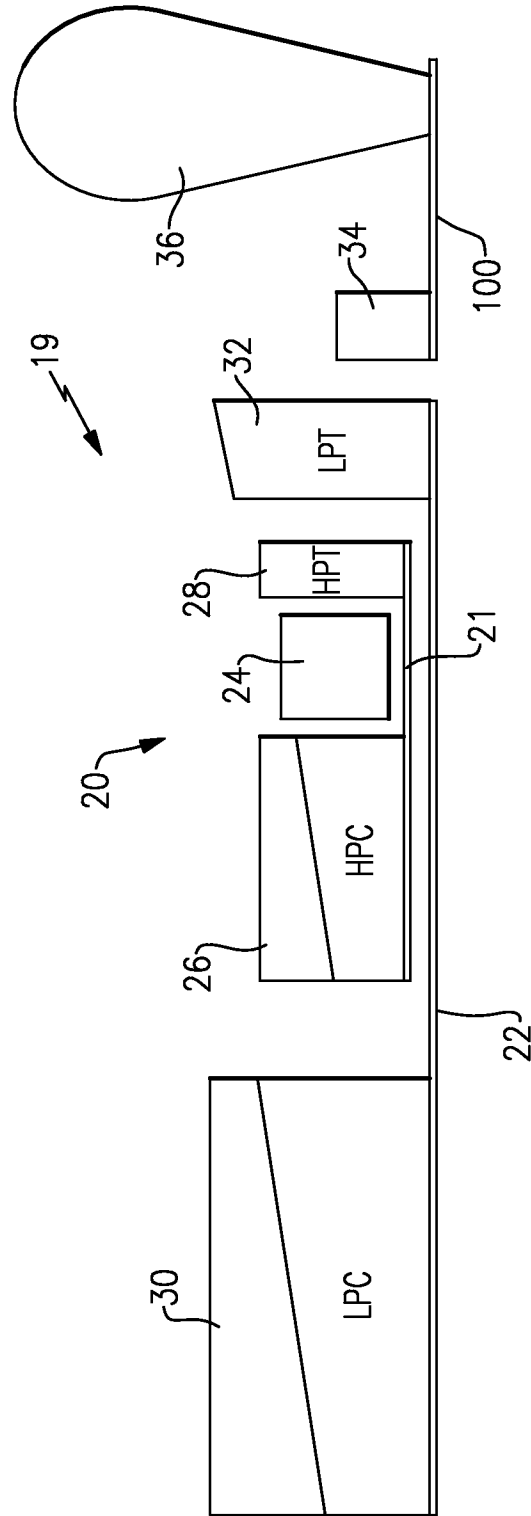


FIG.1

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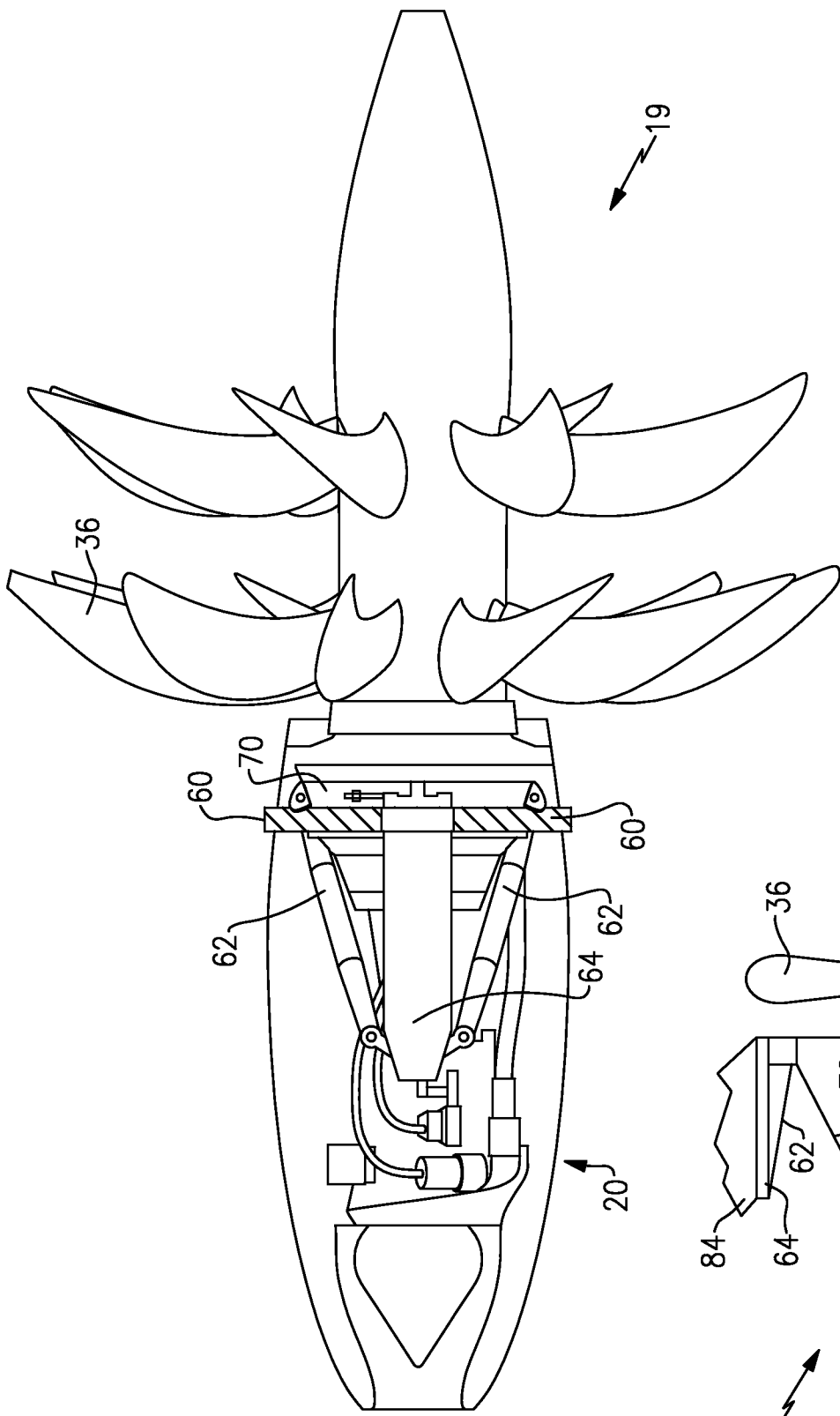


FIG. 2A



FIG. 2B

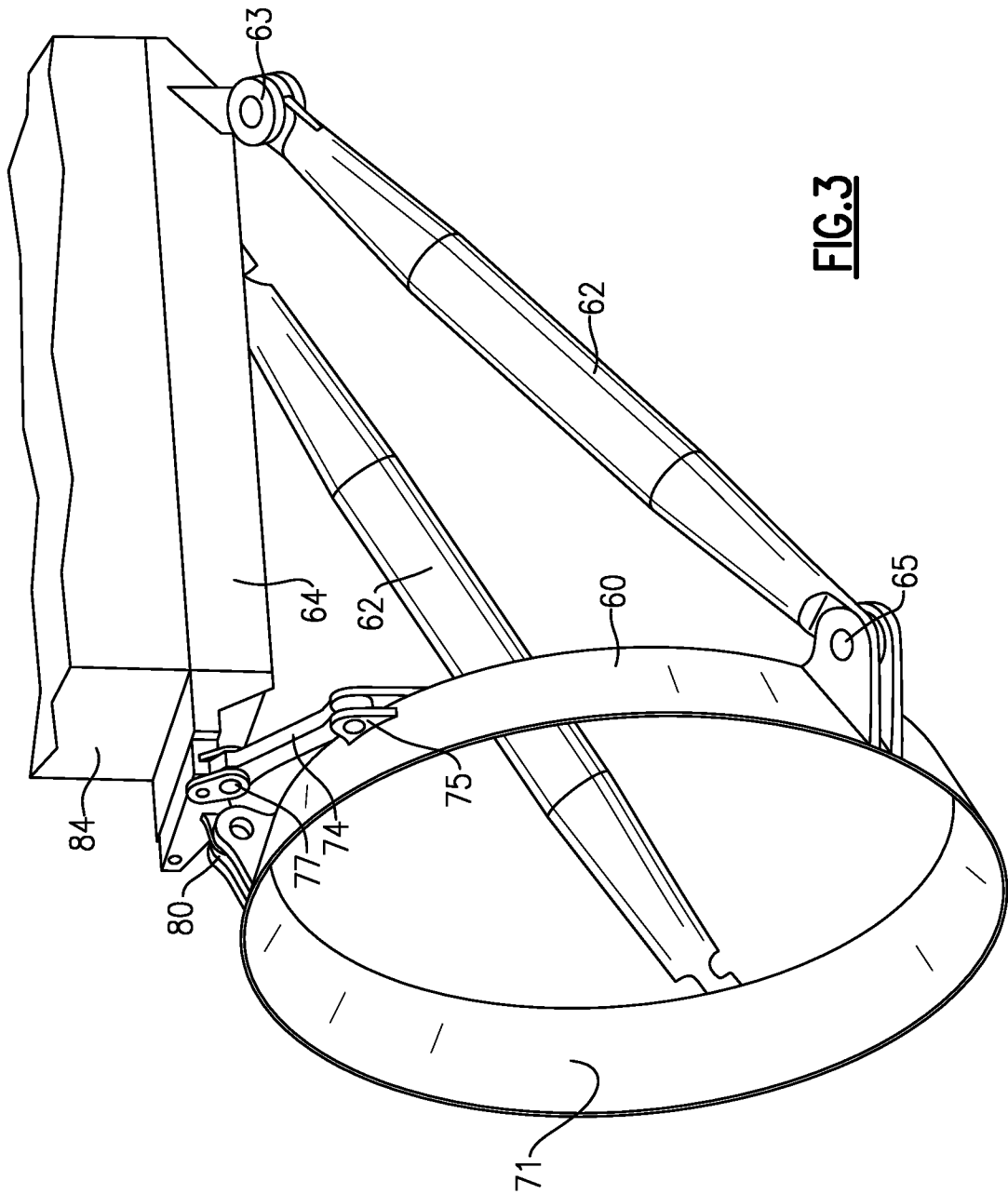


FIG. 3

A. CLASSIFICATION OF SUBJECT MATTER**F02C 7/36(2006.01)i, F02C 7/32(2006.01)i**

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)

F02C 7/36; F02C 7/20; F02C 3/107; F02C 9/00; B64D 27/00; F01D 7/00; G01M 19/00; B64C 11/48; F02C 7/32

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & keywords: turbine, compressor, shaft, free, propulsor, propeller, mount ring and pressure ratio

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011-0311361 A1 (CHARIER, GILLES ALAIN et al.) 22 December 2011 See paragraphs [0042]-[0054] and figures 1,3a,3b.	1-3,9-18
Y		4-8
Y	US 5927644 A (ELLIS, JOE E. et al.) 27 July 1999 See column 2, line 30 - column 3, line 15, column 4, lines 23-34 and figures 2,3.	4-8
A		1-3,9-18
A	US 2012-0023898 A1 (MACKIE, KENNETH J. et al.) 02 February 2012 See paragraphs [0002]-[0005] and figure 1.	1-18
A	US 2011-0142648 A1 (SWIFT, ANDREW et al.) 16 June 2011 See paragraphs [0045]-[0047] and figure 3.	1-18
A	JP 07-063659 A (KAWASAKI HEAVY IND. LTD.) 10 March 1995 See paragraphs [0022]-[0028] and figure 1.	1-18

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

* Special categories of cited documents:

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"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

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Date of the actual completion of the international search

17 March 2014 (17.03.2014)

Date of mailing of the international search report

18 March 2014 (18.03.2014)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2013/044022

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