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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* JEFFERY F. PERLAK, JOSEPH B. STAUBACH, GABRIEL L. SUCIU, JAMES D. HILL, and FREDERICK M. SCHWARZ

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Appeal 2018-007729
Application 14/789,036
Technology Center 3700

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BEFORE DANIEL S. SONG, JILL D. HILL, and RICHARD H. MARSCHALL, *Administrative Patent Judges.*

HILL, *Administrative Patent Judge.*

DECISION ON APPEAL

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 1–14, 16, 17, and 19–22. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM IN PART.

[1] We use the word Appellant to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as the assignee UNITED TECHNOLOGIES CORPORATION. Appeal Br. 1.

## BACKGROUND

Sole independent claim 1, reproduced below with certain limitations italicized, represents the claimed subject matter:

> 1. A gas turbine engine, comprising:
>
> a first compressor and a first turbine for driving the first compressor;
>
> a core section including a second compressor and a second turbine for driving the second compressor;
>
> *a third turbine* arranged fluidly downstream of the first turbine and the second turbine and *configured to drive a power take-off*; and
>
> a first duct system arranged fluidly between the first compressor and the core section, the first duct system arranged to reverse fluid flow before entry into the core section, wherein the first compressor is configured to receive a working fluid flowing in an axially aft direction, the second compressor is configured to receive the working fluid flowing in an axially forward direction opposite the axially aft direction, and the first compressor is directly joined to the first duct system.

## REFERENCES

The prior art relied upon by the Examiner is:

| Name | Reference | Date |
|---|---|---|
| Constant | US 2,504,181 | April 18, 1950 |
| Shohet | US 3,678,690 | July 25, 1972 |
| Buchelt | US 3,738,105 | June 12, 1973 |
| Nakamura | US 8,641,371 B2 | February 4, 2014 |
| Donnelly | US 2014/0306460 A1 | October 16, 2014 |
| Norris | US 8,935,912 B2 | January 20, 2015 |
| Schmittenberg | US 9,500,129 B2 | November 22, 2016 |
| Gunston, B. (2000). *Jane's aero-engines*. Alexandria (VA): Jane's Information Group, 3–8, 61. | | |

REJECTIONS

I. Claims 1–4, 6–9, 11, 12, 14, 19, and 20 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Norris and Donnelly. Final Act. 2.

II. Claim 17 stands rejected under 35 U.S.C. § 103(a) as unpatentable over Norris, Donnelly, and Gunston. Final Act. 6.

III. Claim 1 stands rejected under 35 U.S.C. § 103(a) as unpatentable over Norris and Shohet. Final Act. 7.

IV. Claims 5, 10, and 16 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Norris, Shohet, Nakamura, and Buchelt. Final Act. 8.

V. Claim 13 stands rejected under 35 U.S.C. § 103(a) as unpatentable over Norris, Shohet, Nakamura, Buchelt, and Schmittenberg. Final Act. 9.

VI. Claims 21 and 22 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Norris, Shohet, Nakamura, Buchelt, and Constant. Final Act. 10.

ANALYSIS

For each of Rejections I through VI, Appellant challenges the Examiner's conclusions of obviousness, rather than any factual findings. We address Appellant's arguments below.

*Rejection I – Claims 1–4, 6–9, 11, 12, 14, 19, and 20*

Appellant argues claims 1–4, 6–9, 11, 12, 14, 19, and 20 as a group. We select independent claim 1 as representative. Claims 2–4, 6–9, 11, 12, 14, 19, and 20 stand or fall with claim 1.

Regarding independent claim 1, the Examiner finds, *inter alia*, that Norris discloses a gas turbine engine with a first compressor 106, a first

turbine 110 for driving the first compressor 106, a core section including a second compressor 130 and a second turbine 126 for driving the second compressor 130, and a third turbine 120 downstream of the first and second turbines 110, 126. Final Act. 3. A first duct system 170 extends between the first compressor 106 and the core section 126, 130, and reverses fluid flow direction. *Id*. The Examiner finds that Norris does not disclose its third turbine being configured to drive a power take-off, but Donnelly discloses a similarly-configured gas turbine engine having a third turbine configured to drive a power take-off (i.e., an electrical generator 64), and concludes that it would have been obvious to have Norris's third turbine 120 drive a power take-off as in Donnelly to provide "power output in the range of about 1 kW to about 10 kW," which "could obviously power avionics or engine control systems in an aircraft." *Id.* at 3–4; *see* Donnelly ¶ 73.

The embodiment of Norris' Figure 2 discloses, *inter alia*, a gas turbine engine 100 having a low pressure spool 102, an intermediate pressure spool 111, and a high pressure spool 122. Norris 6:14–37. The low pressure spool includes an intermediate pressure turbine 110 on a first shaft 104 coupled to a fan 106. Norris 6:14–20. One or more generators 121 can be "operatively coupled to" the low pressure spool 102 to share power therewith during portions of the flight envelope. Norris 6:23–25. The intermediate pressure spool 111 has an intermediate compressor 118 and a low pressure turbine 120 coupled to a second shaft 114. Norris 6:26–33. A fan 116 is coupled to shaft 114. *Id.* The high pressure spool 122 includes a high pressure turbine 126 and a high pressure compressor 130. Norris 6:36–43. A primary shaft 140 is coupled to the high pressure turbine 126 and the high pressure compressor 130. Norris 6:57–60.

Donnelly discloses, as prior art illustrated in Figure 1, a gas turbine engine architecture having a gas inlet 51, a combustor 59, an exhaust 66, and three spools: a high pressure turbo compressor spool 53; a low pressure turbo compressor spool 5; and a free power turbine spool 54. Donnelly ¶ 70. The high and low pressure spools 53, 52 each include a compressor 57, 55 and a turbine 60, 61, respectively, connected by a shaft. *Id.* The free power turbine spool 54 includes a turbine 63 and a load device 64 that can be a motor/generator capable of high power operation. *Id.* A prior art shaft 3 that would be used in the gas turbine engine architecture of Donnelly's Figure 1 is shown in Donnelly's Figure 2. *See* Donnelly ¶ 71. On one end of the shaft is a compressor rotor 1, and on the other end of the shaft is a turbine rotor 68. *Id.* This assembly is stated to be "typical of a high-pressure spool." *Id.*

Donnelly discloses adding copper cladding and a stator to a prior art turbo-compressor assembly, which would allow rotation of the turbo-compressor shaft to generate electrical power. *See* Donnelly ¶ 76. The embodiment of Donnelly's Figure 9 adds copper cladding to a turbo-compressor shaft 3, which cooperates with a surrounding rotor to generate electricity. *See* Donnelly Figure 9, ¶¶ 97–98.

*Frustrate Intended Purpose*

Appellant argues that the Examiner's conclusion of obviousness is in error because having Norris' third turbine 120 drive a power take-off as in Donnelly would frustrate the intended purpose of Norris. Appeal Br. 5. According to Appellant, if Norris's low pressure (third) turbine 120 was modified to drive a power take-off, as the Examiner is proposing, it would result in providing less power to the intermediate pressure compressor 118,

"undesirably reducing the [overall pressure ratio ('OPR')] of *Norris*'s engine." *Id.* at 6. Appellant contends that "Norris's low pressure turbine 120 already drives its second shaft 114 coupled to the second fan 116 and intermediate pressure compressor 118," and a skilled artisan "would realize that adding any load to this turbine, and especially the significant load disclosed in Donnelly, would necessarily result in the spool being driven more slowly than without the load," resulting in "less compression by the intermediate compressor 118," leading to "a reduced OPR (the overall compression of the engine), which would be directly counter to Norris's stated purpose." *Id.* at 6–7 (emphasis omitted). Appellant appears to define Norris's intended purpose as achieving a high OPR during certain aircraft modes. Appeal Br. 5–6 (citing Norris, 1:13–25, 3:66–67, 4:13–21, 8:10–33).

The Examiner responds that "the stated purpose of Norris is *not* to achieve a maximum [OPR], but rather to achieve a variable [OPR], for optimization in various modes of flight." Ans. 4 (citing Norris Abstract, 4:18–21). According to the Examiner, configuring Norris's third turbine 120 to drive a power take-off would not have frustrated Norris's intended purpose, because Norris's engine "could have achieved a variable [OPR] using selectively engaged stages of the high pressure compressor, in addition to driving a power take-off with the third turbine." *Id.* The Examiner continues that "[m]any components in modern aircraft require electricity to operate," and "[u]sing the third turbine to drive a generator, i.e. a power take-off, could [provide] electricity to these various components." *Id.* Furthermore, the Examiner proposes using Norris's third turbine 120 to drive a generator in addition to the compressor, in view of Donnelly's Figure

9, which discloses successfully driving both a compressor and a power take-off.

The Examiner has the better argument. The claim only requires that the third turbine be configured to drive a power take-off. No particular load requirement is recited. Further, a skilled artisan would understand the tradeoff between decreasing power to an associated compressor and beneficially providing power from the take-off, and could select an appropriate compromise to achieve desirable results. We, thus, agree with the Examiner that a skilled artisan would understand how to modify Norris's engine to achieve a variable overall pressure ratio using selectively engaged stages of the high pressure compressor, in addition to driving a power take-off with the third turbine. Ans. 4.

*Reasonable Expectation of Success*

Appellant next argues that "there would be no reasonable expectation of success in using *Norris*'s low pressure turbine 120 to drive a power take-off," because Donnelly's free power spool turbine 63 only powers a load device 64, which is distinguished from Donnelly's other spools 52 and 53 that power compressors 55, 57, and may also power other smaller loads 65. Appeal Br. 7. According to Appellant, the Examiner appears to be proposing that Norris's low pressure turbine 120 drive a power take-off in addition to components it already drives, based on the teachings of Donnelly, but a skilled artisan would not understand Donnelly to teach "that a third turbine could power both a compressor and a high power load." *Id.* Appellant contends that Donnelly assigns its high power load to its spool 54 lacking a compressor, while assigning smaller loads 65 to its compressor-driving spools 52 and 53. *Id.* (citing Donnelly ¶ 70 ("Two are nested turbo-

compressor spools and one is a free power turbine spool connected to a load device.")). Appellant further contends that Norris's low pressure turbine 120 already drives its shaft 114, second fan 116, and intermediate pressure compressor 118, such that there is no expectation of success in combining teachings from Donnelly's free spool with Norris's compressor-driving spool, especially where Donnelly distinguishes the two. *Id.* at 8 (citing Norris, 6:26–35, Figure 2).

We are not persuaded by Appellant's argument. As explained above, the embodiment of Donnelly's Figure 9 adds copper cladding to a turbo-compressor shaft 3, which cooperates with a surrounding rotor to generate electricity (Donnelly Figure 9, ¶¶ 97–98), such that a skilled artisan would have had reasonable expectation of success in view of Donnelly's teaching of a third turbine at 68 powering both a compressor at 67 and a high power load at 6.

For these above reasons, we sustain the rejection of independent claim 1. Claims 2–4, 6–9, 11, 12, 14, 19, and 20 fall with claim 1.

*Rejection II – Claim 17*

Claim 17 depends from claim 1. Appellant makes no argument that claim 17 is patentable over Norris, Donnelly, and Gunston, even if claim 1 is not patentable over Norris and Donnelly. We sustain Rejection II for the reasons set forth above regarding claim 1.

*Rejection III – Claim 1*

The Examiner again finds that Norris discloses the claimed invention, except that Norris's low pressure turbine 120 is not disclosed as configured to drive a power take-off. Final Act. 7. The Examiner finds, however, that

Shohet discloses a third turbine 46 downstream from a first turbine 38, and a second turbine 44, the third turbine 46 being configured to drive a power takeoff 74. *Id.* at 8. The Examiner concludes that it would have been obvious to modify Norris's gas turbine to include a third turbine, fluidly downstream of the first and second turbines, which is "configured to drive a power takeoff, as taught by Shohet, to facilitate driving a helicopter rotor driveshaft." *Id.* (citing Shohet 3:54–58).

Appellant contends that Shohet refers to its turbine 46 as a "free turbine" having the sole job of being the shaft horsepower generating free turbine. Appeal Br. 8–9 (citing Shohet, 3:27–65, Figure 1). According to Appellant, "[u]nlike Shohet's [first] turbine 38 that is coupled to its compressor 34, Shohet's [third] turbine 46 is a free turbine operating solely to drive a helicopter rotor." *Id.* at 9 (citing Shohet, 3:27–65, Figure 1) (emphasis omitted).

Norris's disclosure is explained above. Shohet discloses a convertible composite engine with a three coaxial turbines: turbine 38 that drives compressor 34; turbine 44 that drives fan 16; and turbine 46 that is a shaft horsepower generator driving, e.g. a helicopter rotor. Shohet 3:15–52. Shohet discloses its turbine 46 as driving "shaft horsepower take-off means 74, which is typically operatively connected in conventional fashion to drive helicopter rotor drive shaft 78 and hence helicopter rotor 76." Shohet 3:55–58.

Appellant argues that the Examiner's conclusion of obviousness is in error because Shohet "teaches a separate turbine that powers a significant load – a helicopter rotor," and "[m]odifying Norris's third turbine to power a power take-off in view of Shohet's teachings would necessarily reduce its

OPR, directly contrary to [Norris's] intended purpose." Appeal Br. 9 (citing Shohet 3:27–65, Figure 1) (emphasis omitted)).

Appellant also argues that "there would be no reasonable expectation of success in using *Norris*'s low pressure turbine 120 to drive a power take-off," because *Norris*'s low pressure turbine 120 already drives its shaft 114, second fan 116, and intermediate pressure compressor 118. Appeal Br. 9 (citing Norris, 6:26–35, Figure 2). Specifically, Shohet discloses a free turbine 46 with the sole purpose of generating shaft horsepower to power a helicopter rotor. *Id.* at 9–10 (citing Shohet 3:27–65, Figure 1). Shohet describes its turbine 46 as a shaft horsepower generating free turbine, rather than a turbine (e.g., turbine 38) that drives a compressor (e.g., a compressor 34). *Id.* at 10 (citing Shohet 3:22–23, 3:52). According to the Appellant, because Shohet discloses one turbine 38 that drives a compressor and a separate turbine 46 that drives a take-off, Shohet's disclosure "does not provide a reasonable expectation of success that Norris's low pressure turbine 120 could drive a power take off in addition to driving its second fan 116 and intermediate pressure compressor 118." *Id.* (emphasis omitted). Appellant contends that "designating a free turbine to solely power a take-off does not teach that a turbine could power both a compressor and a take-off." *Id.*

We agree with Appellant that the Examiner has not established a rational basis for the proffered reasoning. The Examiner's assertion that Norris's third (low pressure) turbine 120, which drives Norris's fan 116 and compressor 118, could also power a helicopter rotor is speculative and appears unreasonable. If the Examiner is proposing to replace Norris's driven fan 116 and/or compressor 118 with Shohet's rotor, or otherwise

eliminate such components such that the third turbine 120 of Norris becomes a shaft horsepower generator, the Examiner has not explained in sufficient detail how a skilled artisan would understand Norris to be able to accomplish its intended purpose. For this reason we do not sustain Rejection III.

*Rejection IV – Claims 5, 10, and 16*

Claims 5, 10, and 16 ultimately depend from claim 1. The Examiner makes no finding that either Nakamura or Buchelt provide a reason to combine Norris and Shohet to result in the invention claimed. We do not sustain Rejection IV for the reasons set forth above regarding Rejection III.

*Rejection V – Claim 13*

Claim 13 ultimately depends from claim 1. The Examiner makes no finding that Nakamura, Buchelt, or Schmittenberg provide a reason to combine Norris and Shohet to result in the invention claimed. We do not sustain Rejection V for the reasons set forth above regarding Rejection III.

*Rejection VI – Claims 21 and 22*

Claim 21 ultimately depends from claim 1. The Examiner makes no finding that either Nakamura or Buchelt provide a reason to combine Norris and Shohet to result in the invention claimed. We do not sustain Rejection VI for the reasons set forth above regarding Rejection III.

DECISION SUMMARY

In summary:

| Claims Rejected | 35 U.S.C. § | Reference(s)/Basis | Affirmed | Reversed |
|---|---|---|---|---|
| 1–4, 6–9, 11, 12, 14, 19, 20 | 103 | Norris, Donnelly | 1–4, 6–9, 11, 12, 14, 19, 20 | |
| 17 | 103 | Norris, Donnelly, Gunston | 17 | |
| 1 | | Norris, Shohet | | 1 |
| 5, 10, 16 | 103 | Norris, Shohet, Nakamura, Buchelt | | 5, 10, 16 |
| 13 | 103 | Norris, Shohet, Nakamura, Buchelt, Schmittenberg | | 13 |
| 21, 22 | 103 | Norris, Shohet, Nakamura, Buchelt, Constant | | 21, 22 |
| **Overall Outcome** | | | 1–4, 6–9, 11, 12, 14, 17, 19, 20 | 5, 10, 13, 16, 21, 22 |

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED-IN-PART