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(54) **Environmental control system for aircraft utilizing turbo-compressor**

Umgebungsluftregelsystem mit einem Turboverdichter für ein Flugzeug

Système de contrôle d'ambiance comprenant und turbocompresseur pour aéronef

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Description

BACKGROUND OF THE INVENTION

[0001] This application relates to an environmental control system for an aircraft which taps both high and low pressure compressed air for uses on an aircraft.

[0002] Environmental control systems are known, and associated with an aircraft. Typically, these systems tap air from a gas turbine engine on the aircraft, and send it to the aircraft cabin, and other air uses on the aircraft.

[0003] The systems typically tap a low pressure compressed air from a lower pressure compressor location, and a higher pressure compressed air from a higher pressure compressor location. The two are utilized at distinct times during the operation of a gas turbine engine, dependent on the needs, and the available air.

[0004] In the prior art, when the higher pressure air is tapped, it is at a very high temperature. Thus, cooling of the air must occur. It is typical that some form of intercooler or other heat exchanger is included.

[0005] In addition, the higher pressure compressed air has already been compressed beyond the level of the lower pressure compressed air. The more higher pressure compressed air that is diverted away from engine uses, the lower the efficiency of the engine.

[0006] US 6,305,156 B1 discloses an integrated bleed air and engine stating system for an engine. The system includes an air turbine starter subsystem and an air flow subsystem. The air turbine starter subsystem includes a compressor, a turbine, and a common shaft fixed between the compressor and turbine.

[0007] US 2010/010794 A1 discloses a bleed system for a gas turbine engine.

SUMMARY OF THE INVENTION

[0008] The invention provides an environmental control system as claimed in claim 1.

[0009] In another embodiment, a valve is on the first passage associated with the lower pressure tap.

[0010] In another embodiment according to the foregoing embodiment, the valve is a check valve.

[0011] In yet another embodiment, a control valve is positioned on the higher pressure tap, and may be closed to drive air through the first passage associated with said lower pressure tap, or to have air pass through the compressor section of the turbocompressor when the control valve is opened.

[0012] In another embodiment according to the foregoing embodiment, a redundant valve is provided to be closed if the control valve associated with the higher pressure tap fails.

[0013] In another embodiment according to the foregoing embodiment, the redundant valve is positioned to be downstream of a location at which the first passage and the combined outlet intermix into a common conduit.

[0014] Another featured embodiment provides the gas turbine engine of claim 7.

[0015] In another embodiment, a valve is on the first passage associated with the lower pressure tap.

[0016] In another embodiment according to the foregoing embodiment, the valve is a check valve.

[0017] In yet another embodiment, a control valve is positioned on the higher pressure tap, and may be closed to drive air through the first passage associated with said lower pressure tap, or to have air pass through the compressor section of the turbocompressor when the control valve is opened.

[0018] In another embodiment according to the foregoing embodiment, a redundant valve is provided to be closed if the control valve associated with the higher pressure tap fails.

[0019] In another embodiment according to the foregoing embodiment, the redundant valve is positioned to be downstream of a location at which the first passage and the combined outlet intermix into a common conduit.

[0020] These and other features of the invention would be better understood from the following specifications and drawings, the following of which is a brief description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Figure 1 schematically shows a gas turbine engine.
Figure 2 shows an environmental control system for an aircraft.
Figure 3 shows a schematic of the Figure 2 system.

DETAILED DESCRIPTION

[0022] A gas turbine engine 210 is shown in Figure 1. As shown, the engine 210 includes a fan 250 (which includes a plurality of fan blades 20), a compressor section 254 (which includes both a low pressure compressor 256 and a high pressure compressor 258), a combustor 260, and a turbine section 262 (which includes both a high pressure turbine 264 and a low pressure turbine 266). The high pressure compressor 258 is driven, via a first spool 268, by the high pressure turbine 264. The low pressure compressor 256 is driven, via a second spool 270, by the low pressure turbine 266. Also driven by the low pressure turbine 266 are the fan blades 20 of the fan 250, which fan is coupled to the second spool 270 via a gear 272.

[0023] An environmental control system 30 for use on an aircraft is illustrated in Figure 2. A high pressure compression location 134 has a tap 34 as shown in Figure 2. Another tap 32 is at a lower pressure location 132. Locations 132 and 134 may both be within the high pressure compressor 258 or one may be in the lower pressure compressor section 256. However, the tap 34 is downstream of the tap 32, and at a higher pressure location.

[0024] As can be seen from Figure 3, the tap 32 leads to one flow line 36 having a check valve 38, and also into

the compressor section 54 of a turbocompressor 42. The high pressure tap 34 leads into a turbine section 52 of the turbocompressor 42. The exits of both compressor section 54 and turbine section 52 of turbocompressor 42 pass into a common outlet 44.

[0025] The outlet 44 merges with the outlet 36, and both pass through a valve 50 on line 37 leading to an aircraft use 152.

[0026] As shown in Figure 3, the tap 32 alternatively leads to compressor section 54, or into conduit 36 leading to a combined outlet 37. Check valve 38 allows flow from tap 32 to line 36 in a single direction. It also provides some resistance to flow in that direction. The tap 34 leads through a modulating and shutoff valve 40 which can be opened or closed by a controller 41, shown schematically. Air from the higher compressed location at tap 34 is expanded across the turbine section 52 into the outlet 44. This drives the compressor section 54 to compress the air from the tap 32, and increase its pressure. The two outlets mix in conduit 44, and pass to the combined outlet 37. When the compressor section 54 is being driven by the turbine section 52, there is suction applied to the line 32, and thus check valve 38 will remain closed.

[0027] The air from the tap 32 is used generally exclusively under certain conditions when the heat to be rejected is at a maximum. As an example, the air will tend to pass from tap 32 through the check valve 38 to the line 36 during climb and cruise. At such times the valve 40 is maintained closed to limit the diversion of compressed air.

[0028] However, under certain conditions, as an example a descent, the valve 40 is opened, the turbine section 52 is driven. The air from tap 32 passes to the compressor section 54. At such times expanding the compressed air from tap 34 lowers its temperature. Further, mixing it with the lower pressure compressed air 32, even when compressed to a higher pressure by compressor section 54, may eliminate the need for a separate heat exchanger on the line 44. The intermixed air may be at a useful temperature when it reaches the combined outlet 37. The amount of air from the two taps can be varied to achieve this.

[0029] The valve 50 is a control valve which may be closed if the valve 40 fails. At such times, it may be more desirable to supply no air to the system 152, then to have an open diversion from the tap 34.

[0030] The elimination of a required heat exchanger, and the use of less air from the higher compression location, are particularly valuable when combined with a system incorporating a gear drive for the turbo fan, such as shown at 272 in Figure 1.

[0031] 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 invention. For that reason, the following claims should be studied to determine the true scope and content of this invention.

Claims

1. An environmental control system (30) for an aircraft comprising:

   a higher pressure tap (34) which in use receives air from a higher compression location (134) in a main compressor section (254) associated with an aircraft, and a lower pressure tap (32) which in use receives air from a lower pressure location (132) in the main compressor section (254), said lower pressure location (132) being at a lower pressure than said higher pressure location (134);
   a first passage (36) leading to a downstream outlet, said lower pressure tap (32) communicating to the first passage (36);
   a turbocompressor (42) having a turbine section (52) and a compressor section (54), said higher pressure tap (34) leading into the turbine section (52) of the turbocompressor (42) such that in use, air in said higher pressure tap (34) drives said turbine section (52) to in turn drive said compressor section (54) of said turbocompressor (42); and
   a combined outlet (44) of said compressor section (54) of said turbocompressor (42) and said turbine section (52) intermixing and passing downstream to the downstream outlet to be delivered to an aircraft use,
   characterised in that the lower pressure tap (32) has a second passage leading into said compressor section (54) of said turbocompressor (42).

2. The environmental control system (30) as set forth in claim 1, wherein a valve (38) is on said first passage (36) associated with said lower pressure tap (32).

3. The environmental control system (30) as set forth in claim 2, wherein said valve (38) is a check valve.

4. The environmental control system (30) as set forth in claim 2 or 3, wherein a control valve (40) is positioned on said higher pressure tap (34), and, in use, may be closed to drive air through said first passage (36) associated with said lower pressure tap (32), or to have air pass through said compressor section (54) of said turbocompressor (42) when said control valve (38) is opened in use.

5. The environmental control system (30) as set forth in claim 4, wherein a redundant valve (50) is provided to be closed in use if said control valve (40) associated with said higher pressure tap (34) fails.

6. The environmental control system (30) as set forth

in claim 5, wherein said redundant valve (50) is positioned to be downstream of a location at which said first passage (36) and said combined outlet (44) intermix into a common conduit (37).

7. A gas turbine engine (210) comprising:

a fan section (250), in use, delivering air into a main compressor section (254), said main compressor section (254) compressing air and delivering air into a combustion section (260) in use, products of combustion passing from said combustion section (260) over turbine sections (264, 266) in use to drive said fan (250) and main compressor sections (254); and
an environmental control system (30) as claimed in claim 1, wherein the higher pressure tap (34) is at the higher compression location (134) in said main compressor section (254), and the lower pressure tap (32) is at the lower pressure location (132).

8. The gas turbine engine (210) as set forth in claim 7, wherein a valve (38) is on said first passage (36) associated with said lower pressure tap (32).

9. The gas turbine engine (210) as set forth in claim 8, wherein said valve (38) is a check valve.

10. The gas turbine engine (210) as set forth in claim 8 or 9, wherein a control valve (40) is positioned on said higher pressure tap (34), and, in use, may be closed to drive air through said first passage (36) associated with said lower pressure tap (32) when closed, or to have air pass through said compressor section (54) of said turbocompressor (42) when said control valve (40) is opened in use.

11. The gas turbine engine (210) as set forth in claim 10, wherein a redundant valve (50) is provided to be closed in use if said control valve (40) associated with said higher pressure tap (34) fails.

12. The gas turbine engine (210) as set forth in claim 11, wherein said redundant valve (50) is positioned to be downstream of a location at which said first passage (36) and said combined outlet (44) intermix into a common conduit (37).

Patentansprüche

1. Umgebungsluftregelsystem (30) für ein Flugzeug, umfassend:

einen Hahn höheren Drucks (34), der in Verwendung Luft von einem Ort höherer Verdichtung (134) in einem mit einem Flugzeug assoziierten Hauptverdichterabschnitt (254) empfängt, und einen Hahn niederen Drucks (32), der in Verwendung Luft von einem Ort niederen Drucks (132) in dem Hauptverdichterabschnitt (254) empfängt, wobei der Ort niederen Drucks (132) einen niedrigeren Druck als der Ort höheren Drucks (134) aufweist;
einen ersten Kanal (36), der zu einem stromabwärts gelegenen Auslass führt, wobei der Hahn niederen Drucks (32) mit dem ersten Kanal (36) kommuniziert;
einen Turboverdichter (42) mit einem Turbinenabschnitt (52) und einem Verdichterabschnitt (54), wobei der Hahn höheren Drucks (34) in den Turbinenabschnitt (52) des Turboverdichters (42) führt, sodass in Verwendung Luft in dem Hahn höheren Drucks (34) den Turbinenabschnitt (52) antreibt, um wiederum den Verdichterabschnitt (54) des Turboverdichters (42) anzutreiben; und
einen kombinierten Auslass (44) des Verdichterabschnitts (54) des Turboverdichters (42) und des Turbinenabschnitts (52), die sich stromabwärts vermischen und zu dem stromabwärts gelegenen Auslass verlaufen, um für eine Flugzeugverwendung bereitgestellt zu werden,
dadurch gekennzeichnet, dass der Hahn niederen Drucks (32) einen zweiten Kanal aufweist, der in den Verdichterabschnitt (54) des Turboverdichters (42) führt.

2. Umgebungsluftregelsystem (30) nach Anspruch 1, wobei ein Ventil (38) an dem ersten Kanal (36) vorhanden ist, assoziiert mit dem Hahn niederen Drucks (32).

3. Umgebungsluftregelsystem (30) nach Anspruch 2, wobei das Ventil (38) ein Rückschlagventil ist.

4. Umgebungsluftregelsystem (30) nach Anspruch 2 oder 3, wobei das Steuerventil (40) an dem Hahn höheren Drucks (34) positioniert ist und in Verwendung geschlossen sein kann, um Luft durch den ersten Kanal (36), der mit dem Hahn niederen Drucks (32) assoziiert ist, zu treiben oder um Luft durch den Verdichterabschnitt (54) des Turboverdichters (42) laufen zu lassen, wenn das Steuerventil (38) in Verwendung geöffnet ist.

5. Umgebungsluftregelsystem (30) nach Anspruch 4, wobei ein redundantes Ventil (50) bereitgestellt ist, um in Verwendung geschlossen zu sein, wenn das Steuerventil (40), das mit dem Hahn höheren Drucks (34) assoziiert ist, eine Fehlfunktion hat.

6. Umgebungsluftregelsystem (30) nach Anspruch 5, wobei das redundante Ventil (50) so positioniert ist, dass es sich stromabwärts von einem Ort befindet,

an dem sich der erste Kanal (36) und der kombinierte Auslass (44) zu einer gemeinsamen Leitung (37) vermischen.

7. Gasturbinenmotor (210), umfassend:

einen Bläserabschnitt (250), der in Verwendung Luft in einen Hauptverdichterabschnitt (254) bereitstellt, wobei der Hauptverdichterabschnitt (254) Luft verdichtet und Luft in einen Verbrennungsabschnitt (260) in Verwendung bereitstellt, wobei Produkte der Verbrennung aus dem Verbrennungsabschnitt (260) über Turbinenabschnitte (264, 266) in Verwendung laufen, um den Bläser (250) und die Hauptverdichterabschnitte (254) anzutreiben; und
ein Umgebungsluftregelsystem (30) nach Anspruch 1, wobei sich der Hahn höheren Drucks (34) an dem Ort höherer Verdichtung (134) in dem Hauptverdichterabschnitt (254) befindet und sich der Hahn niederen Drucks (32) an dem Ort niederen Drucks (132) befindet.

8. Gasturbinenmotor (210) nach Anspruch 7, wobei ein Ventil (38) an dem ersten Kanal (36) vorhanden ist, assoziiert mit dem Hahn niederen Drucks (32).

9. Gasturbinenmotor (210) nach Anspruch 8, wobei das Ventil (38) ein Rückschlagventil ist.

10. Gasturbinenmotor (210) nach Anspruch 8 oder 9, wobei das Steuerventil (40) an dem Hahn höheren Drucks (34) positioniert ist und in Verwendung geschlossen sein kann, um Luft durch den ersten Kanal (36), der im geschlossenen Zustand mit dem Hahn niederen Drucks (32) assoziiert ist, zu treiben oder um Luft durch den Verdichterabschnitt (54) des Turboverdichters (42) laufen zu lassen, wenn das Steuerventil (40) in Verwendung geöffnet ist.

11. Gasturbinenmotor (210) nach Anspruch 10, wobei ein redundantes Ventil (50) bereitgestellt ist, um in Verwendung geschlossen zu sein, wenn das Steuerventil (40), das mit dem Hahn höheren Drucks (34) assoziiert ist, eine Fehlfunktion hat.

12. Gasturbinenmotor (210) nach Anspruch 11, wobei das redundante Ventil (50) so positioniert ist, dass es sich stromabwärts von einem Ort befindet, an dem sich der erste Kanal (36) und der kombinierte Auslass (44) zu einer gemeinsamen Leitung (37) vermischen.

Revendications

1. Système de contrôle d'ambiance (30) pour un aéronef comprenant :

une prise de pression supérieure (34) qui, en utilisation, reçoit de l'air à partir d'un emplacement à compression supérieure (134) dans une section de compresseur principal (254) associée à un aéronef, et une prise de pression inférieure (32) qui, en utilisation, reçoit de l'air à partir d'un emplacement à pression inférieure (132) dans la section de compresseur principal (254), ledit emplacement à pression inférieure (132) étant à une pression plus faible que ledit emplacement à pression supérieure (134) ;
un premier passage (36) débouchant sur une sortie en aval, ladite prise de pression inférieure (32) communiquant avec le premier passage (36) ;
un turbocompresseur (42) ayant une section de turbine (52) et une section de compresseur (54), ladite prise de pression supérieure (34) débouchant dans la section de turbine (52) du turbocompresseur (42) de sorte qu'en utilisation, de l'air dans ladite prise de pression supérieure (34) entraîne ladite section de turbine (52) pour à son tour entraîner ladite section de compresseur (54) dudit turbocompresseur (42) ; et
une sortie combinée (44) de ladite section de compresseur (54) dudit turbocompresseur (42) et de ladite section de turbine (52) se mélangeant et passant en aval de la sortie en aval pour être distribuées pour une utilisation par l'aéronef,
caractérisé en ce que la prise de pression inférieure (32) possède un second passage débouchant dans ladite section de compresseur (54) dudit turbocompresseur (42).

2. Système de contrôle d'ambiance (30) selon la revendication 1, dans lequel une soupape (38) est sur ledit premier passage (36) associé à ladite prise de pression inférieure (32).

3. Système de contrôle d'ambiance (30) selon la revendication 2, dans lequel ladite soupape (38) est un clapet anti-retour.

4. Système de contrôle d'ambiance (30) selon la revendication 2 ou 3, dans lequel une soupape de contrôle (40) est positionnée sur ladite prise de pression supérieure (34) et, en utilisation, peut être fermée pour entraîner l'air à travers ledit premier passage (36) associé à ladite prise de pression inférieure (32), ou pour que de l'air traverse ladite section de compresseur (54) dudit turbocompresseur (42) lorsque ladite soupape de contrôle (38) est ouverte en utilisation.

5. Système de contrôle d'ambiance (30) selon la revendication 4, dans lequel une soupape redondante (50) est fournie pour être fermée en utilisation si la-

dite soupape de contrôle (40) associée à ladite prise de pression supérieure (34) est défaillante.

6. Système de contrôle d'ambiance (30) selon la revendication 5, dans lequel ladite soupape redondante (50) est positionnée pour être en aval d'un emplacement au niveau duquel ledit premier passage (36) et ladite sortie combinée (44) se mélangent dans un conduit commun (37).

7. Moteur à turbine à gaz (210) comprenant :

une section de soufflante (250), en utilisation, distribuant de l'air dans une section de compresseur principal (254), ladite section de compresseur principal (254) comprimant l'air et distribuant l'air dans une section de combustion (260) en utilisation, des produits de combustion passant de ladite section de combustion (260) au-dessus de sections de turbine (264, 266) en utilisation pour entraîner lesdites sections de soufflante (250) et de compresseur principal (254) ; et

un système de contrôle d'ambiance (30) selon la revendication 1, dans lequel la prise de pression supérieure (34) est au niveau de l'emplacement à compression supérieure (134) dans ladite section de compresseur principal (254), et la prise de pression inférieure (32) est au niveau de l'emplacement à pression inférieure (132).

8. Moteur à turbine à gaz (210) selon la revendication 7, dans lequel une soupape (38) est sur ledit premier passage (36) associé à ladite prise de pression inférieure (32).

9. Moteur à turbine à gaz (210) selon la revendication 8, dans lequel ladite soupape (38) est un clapet antiretour.

10. Moteur à turbine à gaz (210) selon la revendication 8 ou 9, dans lequel une soupape de contrôle (40) est positionnée sur ladite prise de pression supérieure (34) et, en utilisation, peut être fermée pour entraîner l'air à travers ledit premier passage (36) associé à ladite prise de pression inférieure (32) lorsqu'elle est fermée, ou pour que de l'air traverse ladite section de compresseur (54) dudit turbocompresseur (42) lorsque ladite soupape de contrôle (40) est ouverte en utilisation.

11. Moteur à turbine à gaz (210) selon la revendication 10, dans lequel une soupape redondante (50) est fournie pour être fermée en utilisation si ladite soupape de contrôle (40) associée à ladite prise de pression supérieure (34) est défaillante.

12. Moteur à turbine à gaz (210) selon la revendication 11, dans lequel ladite soupape redondante (50) est positionnée pour être en aval d'un emplacement au niveau duquel ledit premier passage (36) et ladite sortie combinée (44) se mélangent dans un conduit commun (37).

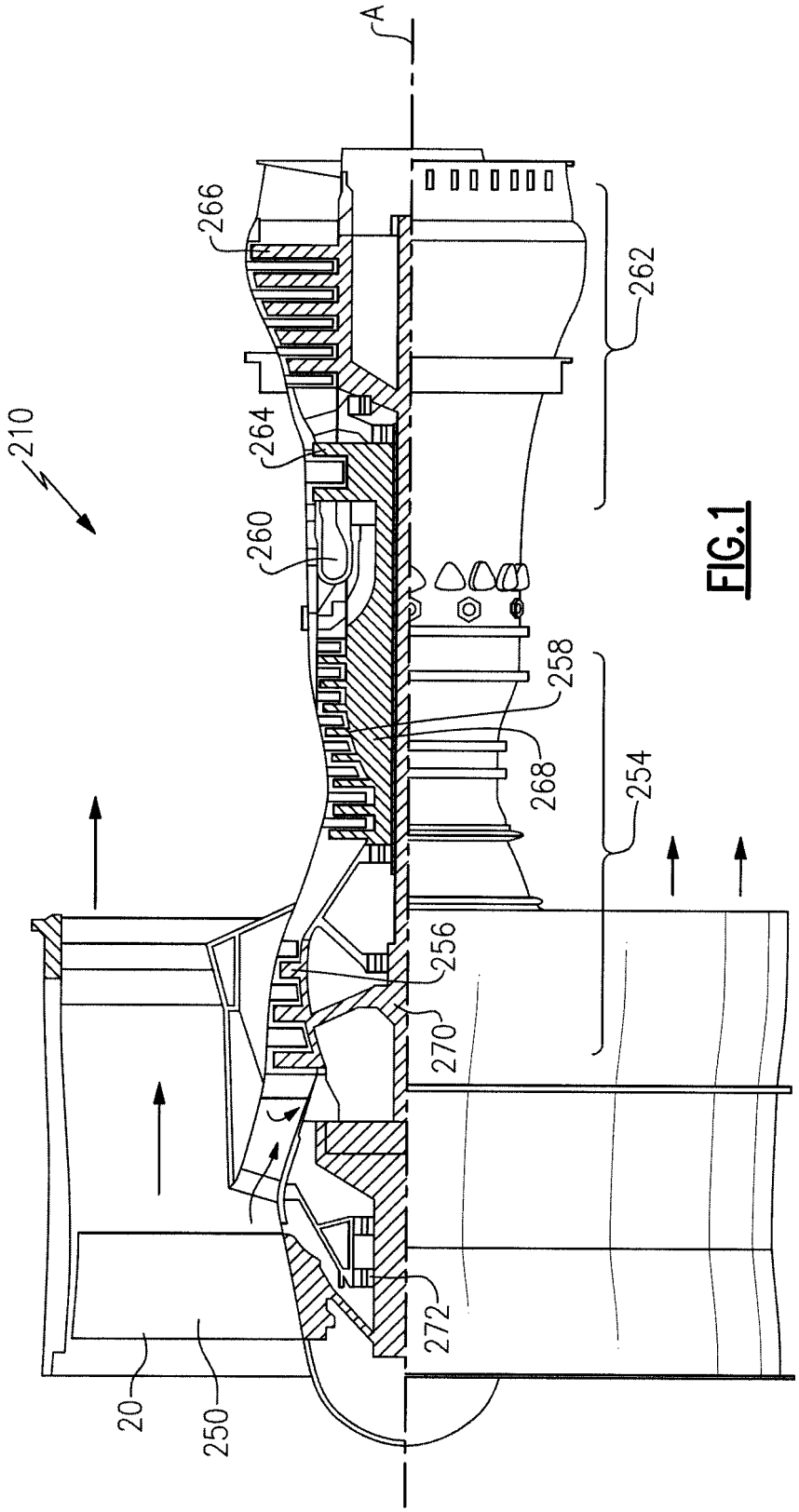

FIG.1

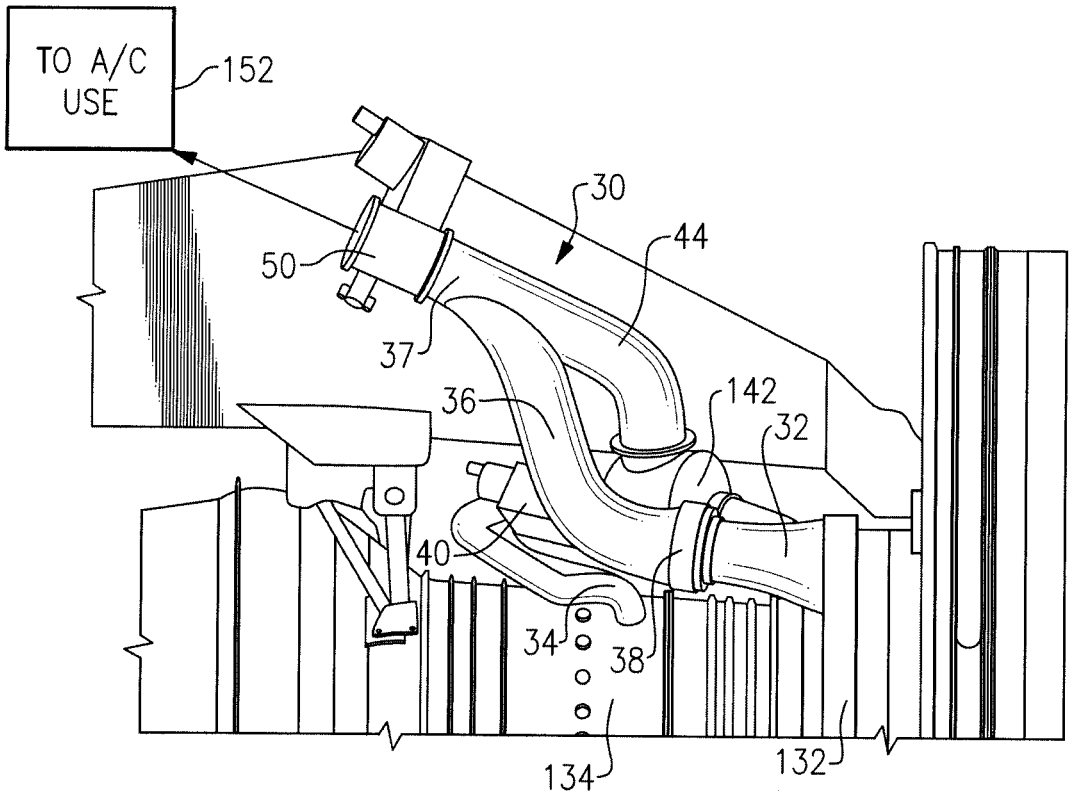
TO A/C USE
152
30
44
50
37
36
142
32
40
34
38
134
132

FIG.2

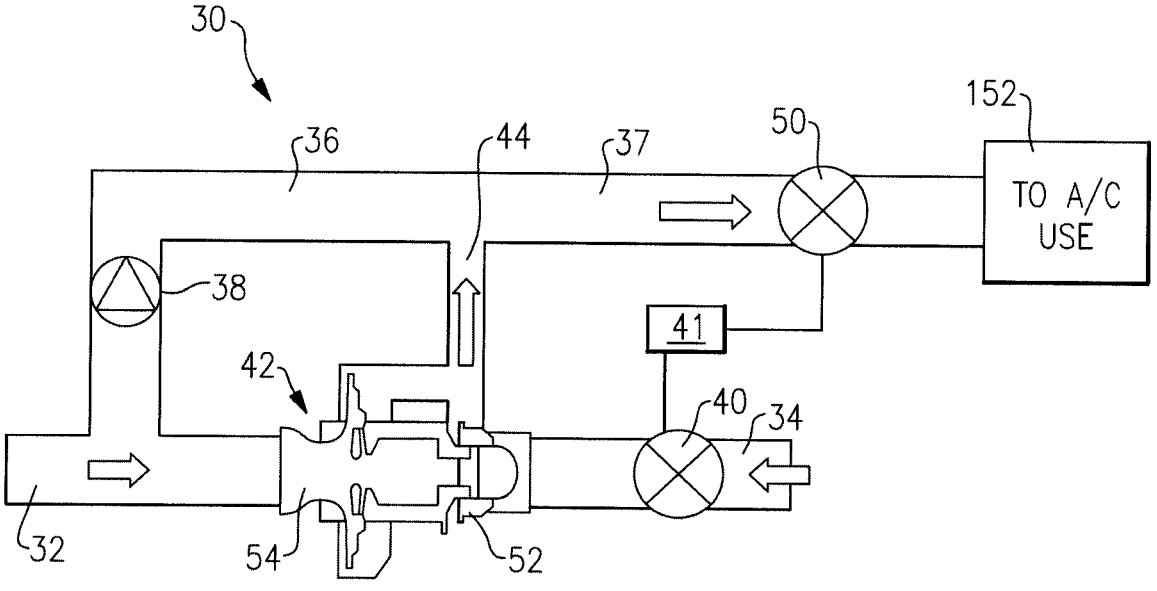
30
36
44
37
50
152
TO A/C USE
38
41
42
40
34
32
54
52

FIG.3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 2010010794 A1 **[0007]**