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(54) **COMBUSTOR WALL CHANNEL COOLING SYSTEM**

(57) The present application provides a combustor liner for use with a gas turbine engine (10). The combustor liner may include a liner wall (140) extending from a head end to an aft end in whole or in part, a number of liner wall cooling channels (130) positioned within the liner wall and extending from an inlet to an outlet, and a number of liner return ducts. The outlets of the liner wall cooling channels (130) may be positioned about the liner return ducts.

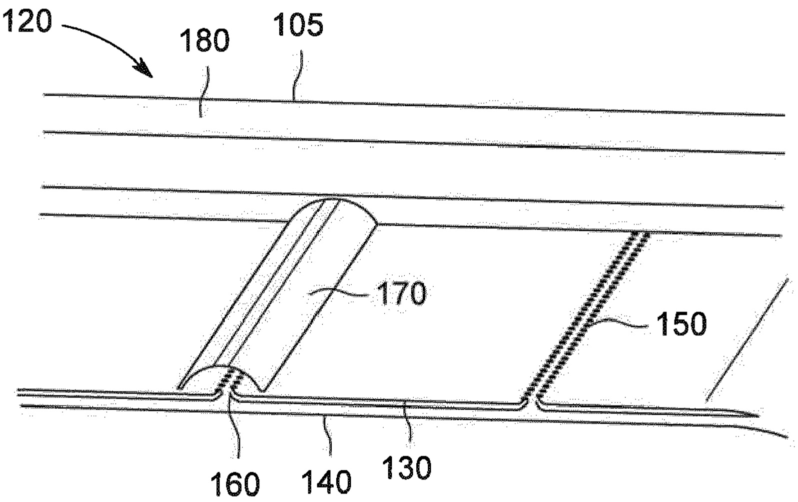

FIG. 4

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Description

TECHNICAL FIELD

[0001] The present application and the resultant patent relate generally to gas turbine engines and more particularly relate to a combustor wall channel cooling system having liner wall cooling channels positioned about a liner wall of a combustor so as to provide wall cooling as well as purge or film cooling flows.

BACKGROUND OF THE INVENTION

[0002] In a gas turbine engine, hot combustion gases generally flow from a combustor through a transition piece and into a turbine along a hot gas path to produce useful work. Because higher temperature combustion flows generally result in an increase in the performance, the efficiency, and the overall power output of the gas turbine engine, the components that are subject to the higher temperature combustion flows must be cooled to allow the gas turbine engine to operate at such increased temperatures without damage or a reduced lifespan.

[0003] One example of a hot gas path component that should be cooled is the combustor liner. Specifically, the hot temperature flows caused by combustion of the fuel-air mixture within the combustor are directed through the combustor liner. Current methods to cool the liner include different types of film cooling techniques and the like. These cooling flows may be driven into the liner or the hot gas path via the overall system pressure drop. Specifically, the air may be driven to the combustor from the compressor or elsewhere via a somewhat complex series of heat exchangers and piping. Such film cooling techniques may be effective but the cooling flow cannot then be used to reduce undesirable emissions. Moreover, such cooling flows may be expensive in that external cooling may be required before use.

[0004] There is thus a desire for improved cooling systems and methods of cooling a combustor liner and/or other types of hot gas path components. Such improved cooling systems and methods may provide adequate cooling with an overall increase in system output and efficiency.

SUMMARY OF THE INVENTION

[0005] The present application and the resultant patent thus provide a combustor liner for use with a gas turbine engine. The combustor liner may include a liner wall extending from a head end to an aft end in whole or in part, a number of liner wall cooling channels positioned within the liner wall and extending from an inlet to an outlet, and a number of liner return ducts. The outlets of the liner wall cooling channels may be positioned about the liner return ducts.

[0006] The present application and the resultant patent further provide a method of cooling a component of a combustor in a gas turbine engine. The method may include the steps of providing a flow of air to a wall of the component, flowing the air through a number of cooling channels in the wall of the component, flowing the air from the cooling channels in the wall of the component into a return duct, and flowing the air in the return duct to a further component.

[0007] The present application and the resultant patent further provide a component for use with a gas turbine engine. The component may include a component wall extending from a head end to an aft end in whole or in part, a number of component wall cooling channels positioned within the component wall and extending from an inlet to an outlet, and a number of component return ducts. The outlets of the component wall cooling channels may be positioned about the component return ducts.

[0008] These and other features and improvements of the present application and the resultant patent will become apparent to one of ordinary skill in the art upon review of the following detailed description when taken in conjunction with the several drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a schematic diagram of a gas turbine engine showing a compressor, a combustor, a turbine, and a load.

Fig. 2 is a schematic diagram of a combustor that may be used with the gas turbine engine of Fig. 1.

Fig. 3 is a perspective view of a combustor liner with a wall channel cooling system as may be described herein.

Fig. 4 is a partial perspective view of the wall channel cooling system of Fig. 3.

Fig. 5 is a partial section view of the wall channel cooling system of Fig. 3.

DETAILED DESCRIPTION

[0010] Referring now to the drawings, in which like numerals refer to like elements throughout the several views, Fig. 1 shows a schematic view of gas turbine engine 10 as may be used herein. The gas turbine engine 10 may include a compressor 15. The compressor 15 compresses an incoming flow of air 20. The compressor 15 delivers the compressed flow of air 20 to a combustor 25. The combustor 25 mixes the compressed flow of air 20 with a pressurized flow of fuel 30 and ignites the mixture to create a flow of combustion gases 35. Although only a single combustor 25 is shown, the gas turbine engine 10 may include any number of combustors 25. The flow of combustion gases 35 is in turn delivered to a turbine 40. The flow of combustion gases 35 drives the turbine 40 so as to produce mechanical work. The mechanical work produced in the turbine 40 drives the compressor 15 via a shaft 45 and an external load 50 such as an electrical generator and the like.

[0011] The gas turbine engine 10 may use natural gas, various types of syngas liquid fuels, and/or other types of fuels and blends thereof. The gas turbine engine 10 may be any one of a number of different gas turbine engines offered by General Electric Company of Schenectady, New York, including, but not limited to, those such as a 7 or a 9 series heavy duty gas turbine engine and the like. The gas turbine engine 10 may have many different configurations and may use other types of components. Other types of gas turbine engines also may be used herein. Multiple gas turbine engines, other types of turbines, and other types of power generation equipment also may be used herein together.

[0012] Fig. 2 shows an example of the combustor 25 that may be used with the gas turbine engine 10 and the like. Generally described, the combustor 25 may include a cover plate 55 at an upstream end thereof. The cover plate 55 may at least partially support a number of fuel nozzles 60 therein. Any number or type of the fuel nozzles 60 may be used herein. The cover plate 55 provides a pathway for the flow of air 20 and the flow of fuel 30 to the fuel nozzles 60.

[0013] The combustor 25 may include a combustor liner 65 disposed within a flow sleeve 70. The arrangement of the liner 65 and the flow sleeve 70 may be substantially concentric and may define an annular flow path 75 therebetween. The flow sleeve 70 may include a number of flow sleeve inlets 80 extending therethrough. The flow sleeve inlets 80 may provide a pathway for at least a portion of the flow air 20 from the compressor 15 or elsewhere. The flow sleeve 70 may be perforated with a pattern of the inlets 80 or otherwise. The combustion liner 65 may define a combustion chamber 85 for the combustion of the flow of air 20 and the flow of fuel 30 downstream of the fuel nozzles 60. The aft end of the combustor 25 may include a transition piece 90. The transition piece 90 may be positioned adjacent to the turbine 40 and may direct the flow of combustion gases 35 thereto. The combustor 25 and the combustor components described herein are for the purpose of example only. Many other types of combustors and combustor components may be known.

[0014] Figs. 3-5 show portions of an example of a combustor 100 as may be described herein. Specifically, a combustor liner 110 is shown. The combustor liner 110 may extend from a head end 105 to an aft end 115. The combustor liner 110 may be substantially similar to that described above but with the addition of a wall channel cooling system 120. The combustor liner 110 may have any suitable size, shape, or configuration.

[0015] The wall channel cooling system 120 may include a number of cooling channels 130. The cooling channels 130 may extend through a liner wall 140. Each of the cooling channels 130 may extend from an inlet 150 to an outlet 160. Any number of the cooling channels 130 may be used herein. In one example, the cooling channels 130 may have a substantially square shape and may have a diameter of about 0.070 inches (about 1.778 millimeters). Alternatively, circular channels may be used with a diameter of about 0.075 inches (about 1.905 millimeters). The cooling channels 130 may have a diameter of about 0.060 inches (about 1.524 millimeters) to about 0.080 inches (about 2.0 millimeters). Other shapes and sizes may be used herein. The length of the cooling channels 130 may be limited to no more than about several inches, *i.e.,* no more than about 2 to 5 inches (about 5.1 to 12-7 centimeters). Other lengths also may be used herein.

[0016] The wall channel cooling system 120 may position the cooling channels 130 in a number of adjacent rows. In one example, 168 rows of the cooling channels 130 may be used. Moreover, about eight to fifteen cooling channels 130 may be positioned each in a number of columns circumferentially arranged about the liner wall 140. Alternatively, the cooling channels 130 may extend for any part of the length of the liner wall 140 in any position. Any number of the cooling channels 130 may be used herein in any suitable size, shape, or configuration. The cooling channels 130 may be cast within the liner wall 140 and/or manufactured in other types of conventional techniques including PSP, braze, machined, and the like. Alternatively, additive manufacturing processes and the like also may be used in whole or in part.

[0017] The inlets 150 of the cooling channels 130 may be open so as to be exposed to the flow of air 20. (The flow sleeve 70 described above need not be used herein.) The outlets 160 of the cooling channels 130 may be positioned within a return duct 170. Any number of the return ducts 170 may be used herein in any suitable size, shape, or configuration. The return ducts 170 extend along the length of the cold side of the liner wall 140 and may be in communication with a head end duct 180. The head end duct 180 may encircle the head end 105 of the liner wall 140 in whole or in part. The head end ducts 180 may be in communication with a number of purge holes 190 and the like through the liner wall 140. In one example, eighty of the purge holes 190 may be used herein with a diameter of about 0.375 inches (about 9.525 milometers). Any number of the purge holes 190 may be used herein in any suitable size, shape, or configuration. The flow of air 20 from the return ducts 170 also may be directed elsewhere. For example, the flow of air 20 may be directed to the premixers, AFS system, purge holes, nozzles, or elsewhere. Further, different return ducts 170 may direct portions of the flow to different locations. Other components and other configurations may be used herein.

[0018] In use, a portion of the flow of air 20 from the compressor or elsewhere may be driven against the liner wall 140 of the combustion liner 110. A portion of the pressure drop may be used to drive the flow into the inlets 150 of the cooling channels 130 where the flow cools the liner wall 140 as it passes therethrough. The cooling channels 130 increase the overall cooling surface area and the heat transfer coefficient so as to improve cooling effectiveness per unit volume of air. The cooling channels 130 may be limited in length because the flow of air 20 therein may pick up heat quickly from the hot side of the liner wall 140. Once a given temperature differential has been reduced by the flow, the cooling effectiveness for a given channel 130 may be diminished such that the next cooling channel 130 with a different flow of air may continue to cool the liner wall 140. The cooling channels 130 may change size (flow area) between the inlets 150 and the exits 160 so as to minimize flow losses within the cooling channels 130. For example, the inlet diameter may be about 0.065 inches (about 1.65 millimeters) and the exit diameter may be about 0.075 inches (about 1.91 millimeters). Other sizes may be used herein. The heated air 20 then may exit the cooling channels 130 via the outlets 160 and may be collected within the return ducts 170. The flow of air 20 flows through the return ducts 170 to the head end duct 180. The flow of air 20 then may be used as a purge or a leakage flow about the head end 105 of the liner 110 via the purge holes 190. Alternatively, the flow of air 20 may be used for other purposes in whole or in part after flowing through the cooling channels 130.

[0019] Only a portion of the overall pressure drop may be used such that the wall channel cooling system 120 directs more and higher pressure air to the fuel-air premixing regions. As such, the combustor 100 may operate at higher pressure ratios for improved operability, fuel flexibility, and a reduction in overall emissions. The wall channel cooling system 120 also eliminates the need for external compressors, heat exchangers, complex piping, and the like for a simplified and less expensive cooling system. Although the wall channel cooling system 120 has been described in the context of the combustor liner 110, the wall channel cooling system 120 may be used with any type of turbine component or pairs of turbine components.

[0020] It should be apparent that the foregoing relates only to certain embodiments of the present application and the resultant patent. Numerous changes and modifications may be made herein by one of ordinary skill in the art without departing from the general spirit and scope of the invention as defined by the following claims and the equivalents thereof.

[0021] Various aspects and embodiments of the present invention are defined by the following numbered clauses:

1. A component for use with a gas turbine engine, comprising:

   a component wall extending from a head end to an aft end in whole or in part;
   a plurality of component wall cooling channels positioned within the component wall;
   wherein the plurality of component wall cooling channels extends from an inlet to an outlet; and
   a plurality of component return ducts;
   wherein the outlets of the plurality of component wall cooling channels are positioned about the plurality of component return ducts.

2. The component of clause 1, wherein the component comprises a combustor liner.

3. The component of any preceding clause, wherein the plurality of component wall cooling channels comprises an inlet and an outlet and wherein the outlets of the plurality of component wall cooling channels are positioned about the plurality of component return ducts.

4. The component of any preceding clause, wherein the plurality of component return ducts is in communication with a duct positioned about the component wall.

5. The component of any preceding clause, wherein the plurality of component wall cooling channels comprises a length of about 5.1 to 20.3 centimeters (about 2 to 5 inches).

Claims

1. A combustor liner (110) for use with a gas turbine engine (10), comprising:

   a liner wall (140) extending from a head end (105) to an aft end (115) in whole or in part;
   a plurality of liner wall cooling channels (130) positioned within the liner wall (140);
   wherein the plurality of liner wall cooling channels (130) extends from an inlet (150) to an outlet (160); and
   a plurality of liner return ducts (170);
   wherein the outlets of the plurality of liner wall cooling channels (130) are positioned about the plurality of liner return ducts (170).

2. The combustor liner (110) of claim 1, wherein the plurality of liner return ducts (170) is in communication with a head end duct (180) positioned about the head end (105) of the liner wall (140).

3. The combustor liner (110) of claim 2, wherein the liner wall (140) comprises a plurality of purge holes (190) in communication with the head end duct (180).

4. The combustor liner (110) of any of claims 1 to 3, wherein the inlets (150) of the plurality of liner wall cooling channels (130) are positioned in communication with a flow of air (20) in a flow path (75) within a flow sleeve (70).

5. The combustor liner (110) of any of claims 1 to 4, wherein the plurality of liner wall cooling channels (130) comprises a substantially square shape or a substantially round shape.

6. The combustor liner (110) of any of claims 1 to 5, wherein the plurality of liner wall cooling channels (130) comprises a length of about 5.1 to 12.7 centimeters (about 2 to 5 inches).

7. The combustor liner (100) of any preceding claim, wherein the plurality of liner wall cooling channels (130) comprises a diameter of about 1.524 millimeters (about 0.060 inches) to about 2.0 millimeters (about 0.080 inches).

8. The combustor liner (100) of any preceding claim, wherein the plurality of liner wall cooling channels (130) comprise a inlet diameter of about 1.65 millimeters (about 0.065 inches) and an exit diameter of about 1.91 millimeters (about 0.075 inches).

9. The combustor liner (100) of any preceding claim, wherein the plurality of liner wall cooling channels (130) may be positioned in a plurality of columns on the liner wall (140).

10. The combustor liner (110) of claim 9, wherein eight to fifteen of the plurality of liner wall cooling channels (130) may be positioned in each of the plurality of columns on the liner wall (140).

11. The combustor liner (110) of any preceding claim, wherein the plurality of liner wall cooling channels (130) is cast into the liner wall.

12. The combustor liner (110) of any preceding claim, wherein the plurality of liner wall cooling channels (130) is formed in an additive manufacturing process.

13. The combustor liner (110) of any preceding claim, wherein the liner wall (140) surrounds a combustion chamber (85).

14. A method of cooling a component (110) in a gas turbine engine (10), comprising:

providing a flow of air (20) to a wall (140) of the component (110);
flowing the air (20) through a plurality of cooling channels (130) in the wall (140) of the component (110);
flowing the air (20) from the plurality of cooling channels (130) in the wall (140) of the component (110) into a return duct (170); and
flowing the air (20) in the return duct (170) to a further component.

15. The method of cooling of claim 14, wherein the step of flowing the air (20) in the return duct (170) to a further component comprises flowing the air (20) in the return duct (170) to a head end duct (180).

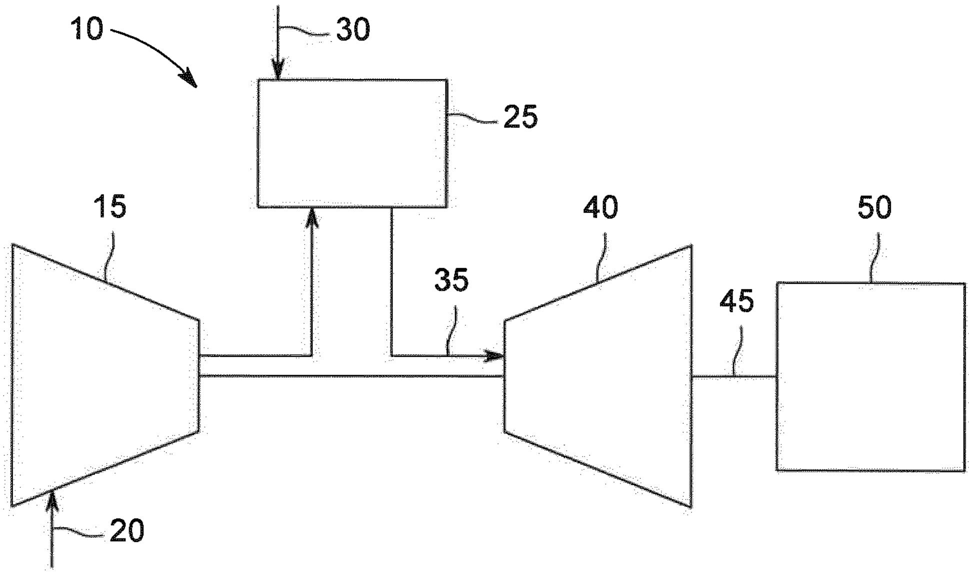
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FIG. 1

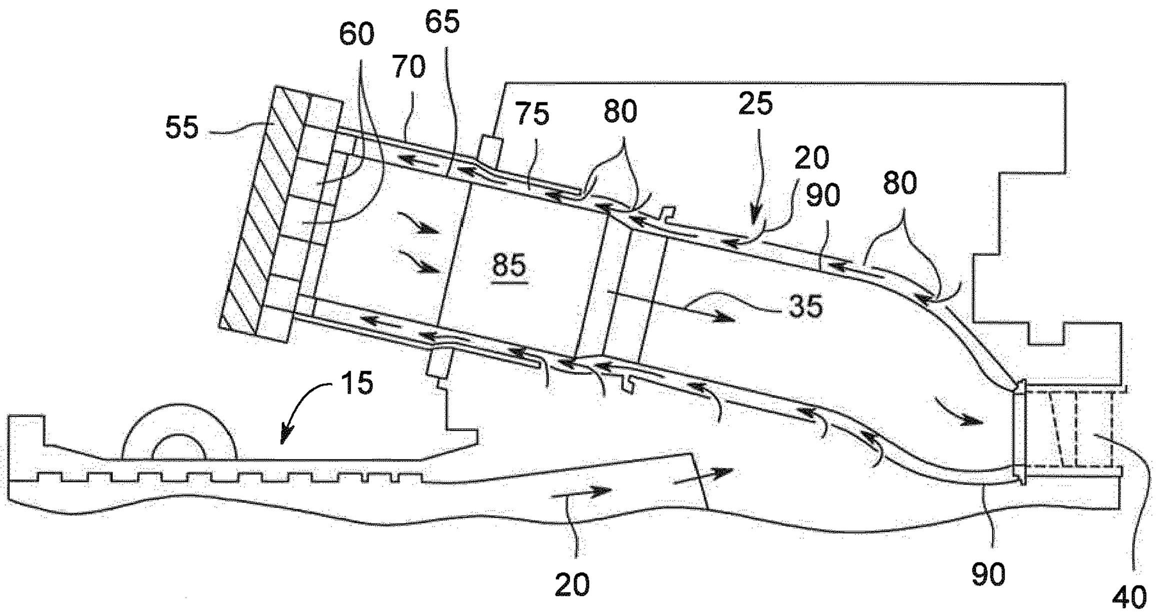
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FIG. 2

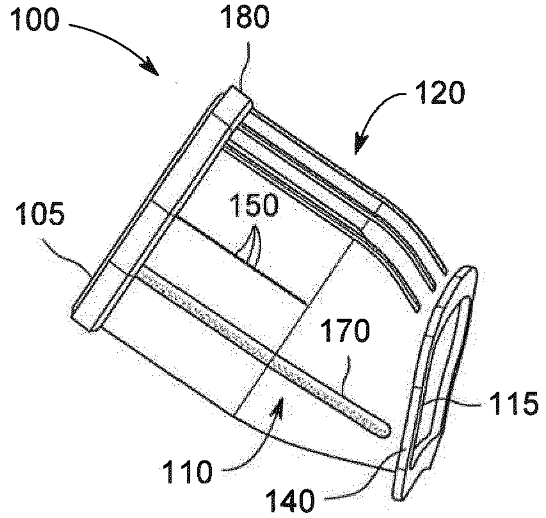

FIG. 3

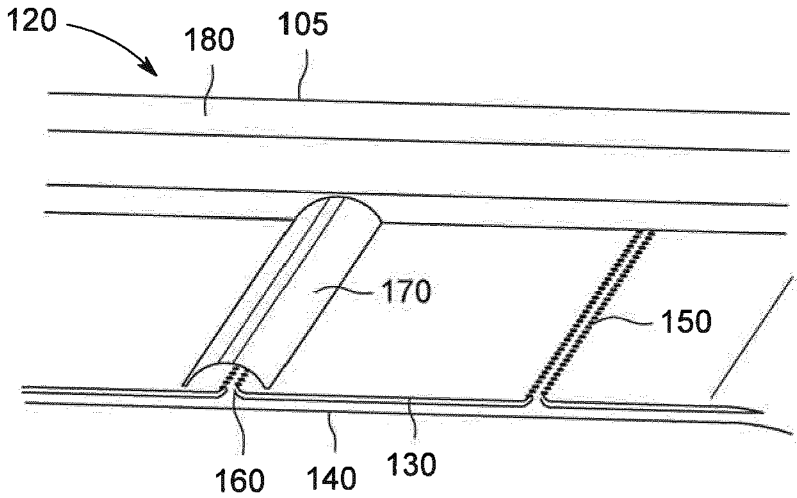

FIG. 4

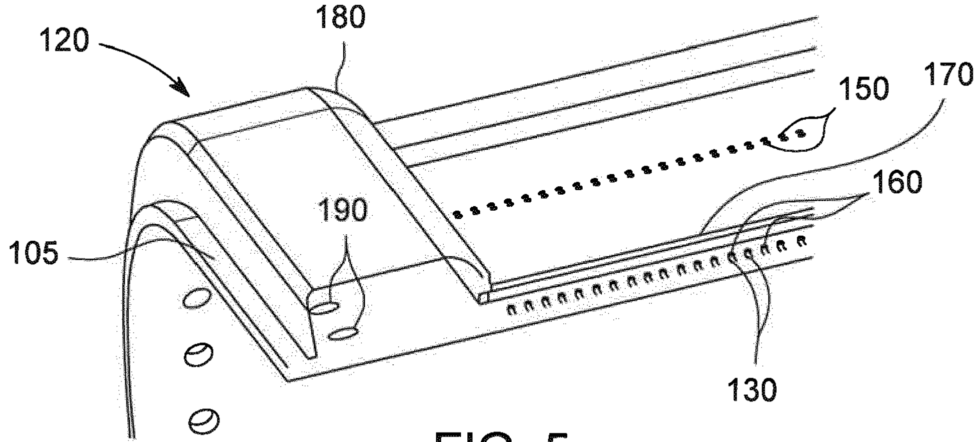

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 16 19 9642

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The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	10 April 2017	Munteh, Louis

CATEGORY OF CITED DOCUMENTS

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