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(54) NOISE REDUCING SILENCER WITH A SPIRALLY SHAPED TUBE FOR A COMPRESSOR

(57) A silencer for a compressor, the silencer including a housing, a spirally shaped silencer tube provided in the housing and having an inlet and an outlet, a connecting element connected to the silencer core to connect the outlet of the silencer core to an inlet of a compressor. The silencer tube is provided to reduce noise during operation of the compressor.

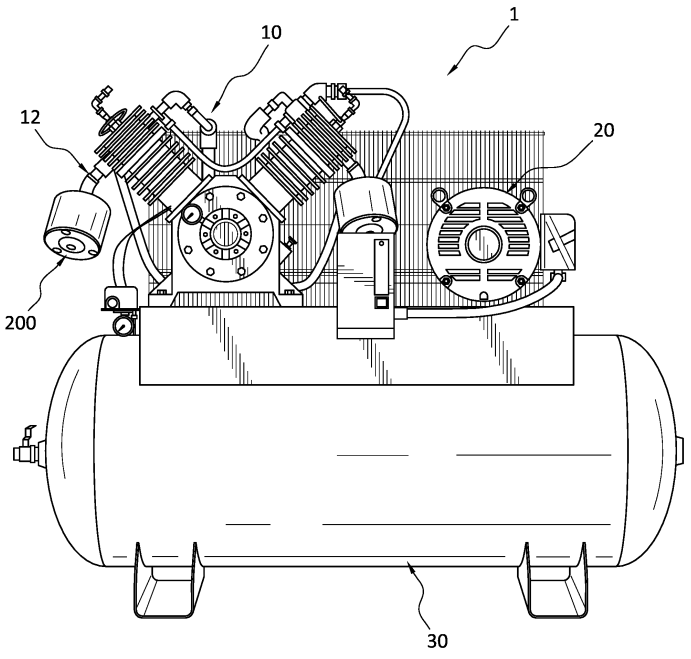

FIG. 1

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Description

CROSS REFERENCE OF RELATED APPLICATIONS

[0001] This application claims priority to provisional application number 62/683,500, filed June 11, 2018, which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a compressor, and more particularly to a silencer for reducing the noise emitted from certain compressors, especially reciprocating compressors or piston compressors.

BACKGROUND

[0003] Compressors typically include a motor that drives a compressor element to pressurize air. The compressor element can be a reciprocating compressor or piston compressor, a centrifugal compressor, a scroll compressor, a screw compressor having male and female compressor elements, or the like. All such compressor elements have a suction side for receiving inlet air, e.g., through an inlet air filter, and an outlet side for discharging the compressed air to a tank and/or distribution header for distributing the compressed air to a network of users. During the compression process, due to the large volume of air provided through the air inlet of the compressor, noise is generated at the air inlet or suction side.

[0004] For example, in a reciprocating compressor, which is widely used in various industrial and domestic applications, the motor is used to drive a crankshaft that moves pistons in a reciprocating manner, where gas enters the suction side, typically through an inlet manifold, is compressed via the pistons being driven in a reciprocating manner, and then discharged at high pressure into a tank.

[0005] However, during operation of the reciprocating compressor, noise is emitted from the air inlet or suction side of the reciprocating compressor when the air is drawn through the inlet manifold, e.g., due to the turbulence of the air moved through the inlet. Typically, the prior art reciprocating compressor has little to no provisions to reduce the noise it generates or employs conventional structures to reduce this noise. For example, one conventional structure draws the inlet air through a large, bulky, and remotely mounted baffling box, where such structure is costly and restricts the inlet air flow by employing a long tube that connects the suction side or air inlet of the compressor to the large baffling box, which reduces the efficiency of the compressor.

[0006] In view of such drawbacks, there is a need to provide a simpler, smaller, and more cost-effective structure for reducing the noise generated at the air inlet of compressors that does not reduce the efficiency of the compressor.

SUMMARY OF THE INVENTION

[0007] The present invention is provided to solve the deficiencies of the prior art by providing improvements over the prior art in several ways. For example, it is an object of the present invention to provide a silencer that costs less, is much smaller, and can be attached directly to the compressor air inlet to reduce or eliminate restriction to the inlet air flow.

[0008] In order to achieve the objectives of the present invention, a noise reducing silencer is provided that is attached directly to the compressor air inlet of a compressor that has a silencer core which reduces and/or eliminates the noise at the air inlet to provide a quieter compressor without adding significant extra costs and without significantly reducing efficiency. In one embodiment of the invention, the silencer comprises a housing, a silencer core, where the silencer core comprises a generally spirally shaped silencer tube, and a connecting element for connecting the silencer core to the air inlet of a compressor. In order to reduce costs and size, the silencer can be incorporated into a conventional air filter for a compressor and/or include filtering elements and attached directly to the compressor intake/air inlet. The noise reducing silencer can also be attached to the air filter as a separate element.

[0009] The spirally shape silencer tube can be made of metal, plastic, a composite material, or a combination thereof or include material to dampen the noise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The features and objects of the present invention are more clearly understood from the detailed description of preferred embodiments taken in conjunction with the accompanying drawings, in which:

Fig. 1 illustrates a perspective view of a compressor with a silencer;

Fig. 2 illustrates an exploded perspective view of a silencer according to the first embodiment of the present invention.

[0011] In the various figures, similar elements are provided with similar reference numbers. It should be noted that the drawing figures are not necessarily drawn to scale, or proportion, but instead are drawn to provide a better understanding of the components thereof, and are not intended to be limiting in scope, but rather provide exemplary illustrations.

DETAILED DESCRIPTION OF THE INVENTION

[0012] The present invention will be described with respect to particular embodiments and with reference to

certain drawings but the invention is not limited thereto and can be combined interchangeably with certain features in the different embodiments.

[0013] FIG. 1 illustrates a compressor installation, which can be a single or two stage reciprocating compressor or piston compressor, a centrifugal compressor, a scroll compressor, a screw compressor having male and female compressor elements, or the like, that includes a noise reducing silencer 200 according to the present invention. In this embodiment, the compressor element 10 is illustrated as a reciprocating compressor having at least two piston cylinders, preferably four piston cylinders and up to ten piston cylinders, for compressing air received from an air inlet 12 of the compressor element 10. The noise reducing silencer 200 is provided at the air inlet 12 for filtering the inlet air. The compressor element 10 is driven by a motor 20, e.g., a gas driven or electrically driven motor, that rotates the crankshaft to reciprocally rotate pistons to compress the air in the piston cylinders of the compressor element 10. The compressed air is then discharged from the compressor element 10 and stored in the compressor tank 30.

[0014] The noise reducing silencer 200 provided at the air inlet 12 is provided to reduce and/or eliminate the noise generated when the air is suctioned or drawn into the air inlet 12 of the compressor element 10. The noise reducing silencer 200 can be used to replace the standard air filters used for reciprocating air compressors by including air filter media in the noise reducing silencer, or be attached to the standard air filters, e.g., series connection.

[0015] As seen in Fig. 2, in one embodiment of the invention, the noise reducing silencer 200 includes a housing 210 that includes a base 212 and cover 214. The housing 210 also includes openings 216 provided along an outer circumference of the housing to allow air to be drawn into the noise reducing silencer 200, where at least one, preferably four, and up to eight or more openings are provided in the housing. A silencer core 220 is comprises at least one inlet 221 and a spirally shaped silencer tube within the housing 210 for guiding the air from an opening 216 of the housing to an exit of the housing to the inlet of the compressor element (not shown) through a connecting element 230. The connecting element 230 is provided along an inner side of the windings 222 of the spirally shaped silencer tube 220 and includes an interface for connecting to the spirally shaped silencer tube 220 as well as an interface for connecting to the outlet 2121 of the base 212, e.g., screw fittings, welding, pinned connection, cam fittings, compression fitting, etc. The outlet 2121 of the base 212 is then configured to be connected to the air inlet of a compressor, e.g., screw fittings, welding, pinned connection, cam fittings, compression fitting, etc.

[0016] The noise reducing silencer 200 can also be provided with a filtering element 240 to filter the inlet air before being sent to the compressor, where the filtering element 240 can include a filter 242 and a filter screen 244 that is configured to support the filter 242. The filter 242 can include a variety of filtering media for example, coalescing filters, particulate filters, and carbon filters, to remove at least solid particles, liquids, aerosols, hydrocarbon vapours, etc.

[0017] In the embodiment of the invention that includes the filtering element, the noise reducing silencer 200 is constructed in a way so that the connecting element 230 is provided centrally in the housing 210 along an inner side of the windings 222 of the spirally shaped silencer tube 220. The connecting element 230 can be welded, screw fitted, press-fitted, glued, or similarly attached to the outlet 2121 of the housing 210. The filter screen 244 is then provided along an outer side and surrounding the spirally shaped silencer tube 220, and the filter 242 is provided along an outer surface of the filter screen 244, where the filter screen 244 and/or the filter 242 can be provided to freely float in the housing or attached to the housing using an adhesive, welding, tie-downs, etc. The housing 210, base 212, and cover 214 enclose the elements of the noise reducing silencer 200 and are connectible using tab/groove configurations, welding, adhesives, crimping, screwing, or other similar structures for coupling the base 212 and cover 214 to the housing 210.

[0018] The operation of the noise reducing silencer 200 is provided as follows: Air is drawn through the openings 216 in the housing 210 into the noise reducing silencer 200 which is filtered through the filter 242 and filter screen 244. The air then enters into the inlet 221 of the spirally shaped silencer tube 220 and passes through several of the windings 222 of the spirally shaped silencer tube 220. After passing through several of the windings 222, the air then exits the spirally shaped silencer tube 220 to the connecting element 230 and drawn into the air inlet of the compressor element through the outlet 2121 of the base 212. It is also appreciated that the spirally shaped silencer tube 220 can have multiple inlets around its periphery, which allow air to be further drawn into the silencer tube, but still provides the benefits of noise reduction.

[0019] Typically, in such compressor elements, noise is generated at the air inlet due to the suction of air, however, in the present invention, the noise from the suction of air is reduced and/or eliminated by the noise reducing silencer 200. Without limiting the invention by theory, it is understood that the noise is reduced and/or eliminated due to the use of the spirally shaped silencer tube of the silencer core 220 where the number of windings 222 create an indirect path for the sound to travel. That is, it is understood that the spiral shape of the spirally shaped silencer tube prevents a straight path for the sound to travel and is instead reflected from all surfaces causing noise cancelation and attenuation. For example, the spiral windings provide a sealed surface for a broad spectrum of sound frequencies that are diffused or absorbed by the spirally shaped silencer tube 220. The spiral windings include at least one winding, preferably four windings, and up to ten or more windings which are used to

reduce and/or eliminate the noise typically generated at the air inlet. The number of windings that are appropriate depends on the application and volume of air to be passed through the spirally shaped silencer tube 220.

[0020] The spirally shaped silencer tube 220 can be made of a composite material, such as plastic, rubber, metal, carbon, natural fibers, fiberglass, or a combination thereof, to absorb a broad spectrum of frequencies and can further include porous or corrugated tubes or foams inside the spirally shaped silencer tube 220 to further absorb noise. Noise reduction can be further enhanced by coating the silencer core with a sound absorbing material, such as sound proofing paint or gel, foam, fiberglass, ceramics or the like. This concept can be stacked for increased noise reduction.

[0021] The size of the assembled noise reducing silencer may be closely matched to the size of the standard air filters that are typically used for reciprocating air compressors. In this way, the standard air filters can be replaced by the noise reducing silencer to provide a compact arrangement of such a device.

[0022] In view of such structure and features, the present invention solves the deficiencies of the prior art by providing a noise reducing silencer for a compressor installation that includes a silencer core that is configured to reduce and/or eliminate noise generated at an air inlet of a compressor, which is an improvement over the prior art in several ways. These features cost less than a baffle box provided at an air inlet of a compressor. The present invention allows a smaller size silencer due to the compact arrangement of the silencer core, and may be attached directly to the compressor inlet with the air filter to reduce or eliminate restriction to the inlet air flow.

[0023] The invention discussed herein is directed to specific embodiments, but the design is not limited to the description of the exemplary invention but only by the scope of the appended claims. As a result, there are multiple embodiments that employ the beneficial characteristics of the invention, each providing a different advantage and that are combinable/interchangeable with various aspects of the different embodiments of the invention that does not depart from the spirit and scope of the invention. For example, the parts of the silencer can be arranged in different configurations depending on the application, e.g., can be used as an outside-inside or inside-outside flow filter.

Claims

1. A silencer for a compressor, said silencer comprising:

   a housing;
   a spirally shaped silencer tube provided in the housing and having an inlet and an outlet; and
   a connecting element configured to connect the outlet of the spirally shaped silencer tube to an air inlet of the compressor.

2. The silencer according to claim 1, wherein the spirally shaped tube is configured to reduce noise generated from air entering the compressor during operation.

3. The silencer according to claim 1, wherein the connecting element is provided along an inner side of windings of the spirally shaped silencer tube.

4. The silencer according to claim 1, further comprising a filter element and a filter screen configured in a way to support the filter element, wherein said filter element and filter screen are provided circumferentially around an outer side of the spirally shaped silencer tube.

5. The silencer according to claim 1, wherein the spirally shaped silencer tube comprises composite material.

6. The silencer according to claim 1, wherein the housing comprises a base and a cover for enclosing the housing, and wherein said housing comprises at least one opening for an inlet airflow.

7. The silencer according to claim 2, wherein the spirally shaped silencer tube comprises at least two windings.

8. The silencer according to claim 1, wherein the spirally shaped silence tube is coated with a sound absorbing material.

9. A compressor installation comprising:

   a motor;
   a compressor element;
   and a silencer connected to an air inlet of the compressor element, said silencer comprising a housing, a spirally shaped silencer tube provided in the housing, said silencer tube having an inlet and an outlet, and a connecting element that connects the outlet of the silencer tube to the air inlet of the compressor element,
   wherein the silencer tube is configured in a way to reduce noise generated from a gas or gasses entering into the compressor during operation.

10. The compressor installation according to claim 9, wherein the compressor is a reciprocating compressor, and the gas is air.

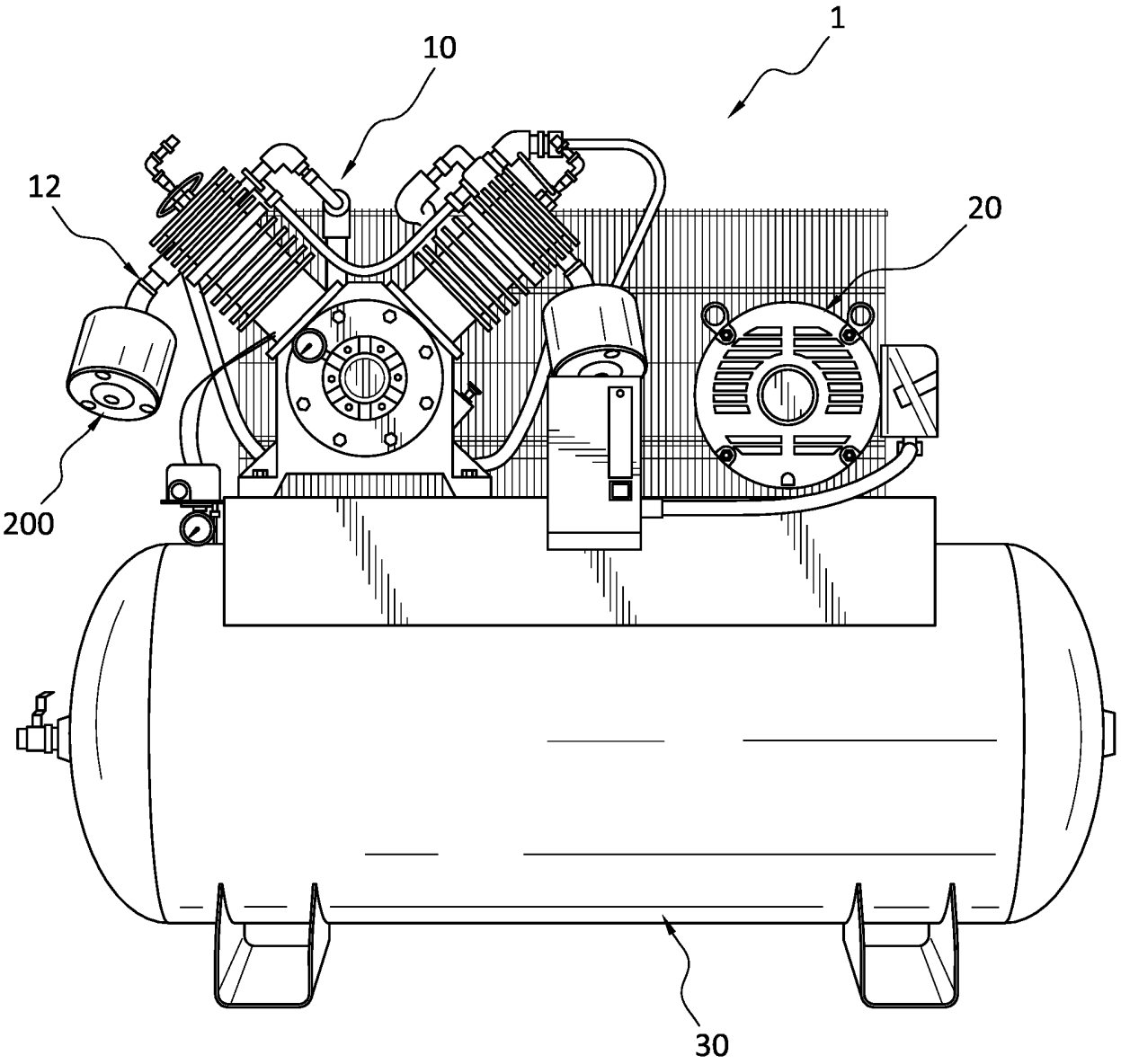

FIG. 1

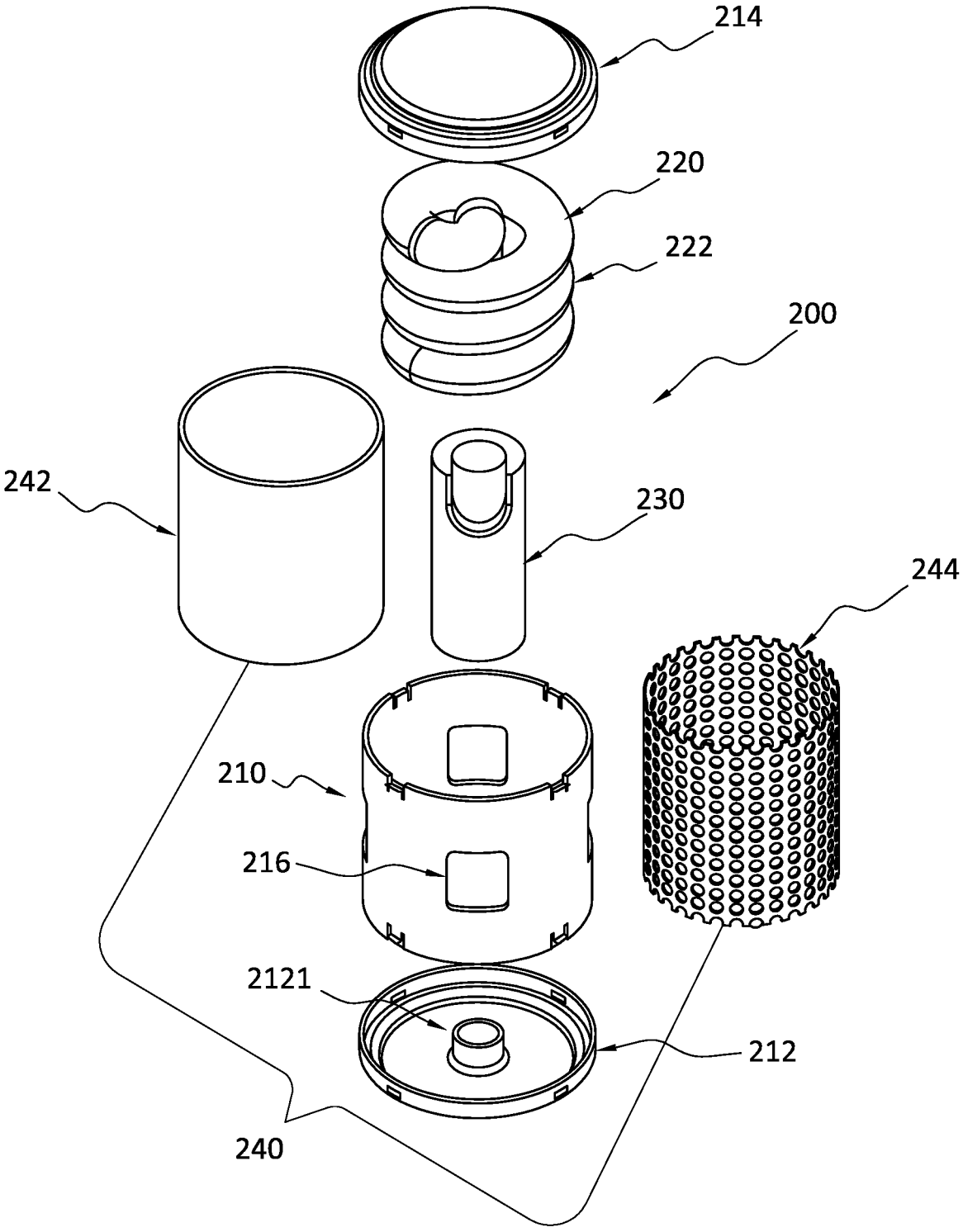

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 6988

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 October 2019	Homan, Peter

CATEGORY OF CITED DOCUMENTS

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