Spare Set of Claims

CLAIMS

1. A method of heat treating a steel component, comprising:

heating the steel component in a treatment atmosphere to an elevated temperature for a period of time sufficient to form a modified layer on the surface of the steel component;

wherein the treatment atmosphere comprises:

a carbon-containing gas suitable for creating a carbon-enriched layer on the surface of the steel component; and

a nitrogen-containing gas suitable for creating a nitrogen-enriched layer on the surface of the steel component.

2. A method as claimed in claim 1, wherein the elevated temperature is no more than 900 Celsius.

3. A method as claimed in claim 1 or 2, wherein the carbon-containing gas is endothermic gas, and the nitrogen-containing gas is ammonia.

4. A method as claimed in claim 3, wherein the treatment atmosphere contains up to 11% by volume ammonia, the balance being endothermic gas.

5. A method as claimed in any preceding claim comprising:

heating the steel component in the carbon-containing gas at a temperature of 900–955 Celsius for a first period;

introducing the nitrogen-containing gas; and

heating the steel component in the treatment atmosphere including the nitrogen-containing gas at a temperature of about 850 Celsius for a second period.

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Construction

Claim 1

A method of heat treating a steel component,	Independent method claim (also covers the direct product of the process). Modifies the surface properties of a steel component using heat (page 4, lines 1-3). Steel – an alloy of iron. May have a carbon content of between 0.002% and 2.1% by weight as this is described as typical therefore not an essential feature (page 4, lines 4-5). Steel shall include nickel steel and lower grade steel as this is what is exemplified in the patent (page 6, line 23). Steel component – shall be taken to mean an object which is made of steel. The object can be of different	1 1

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	sizes as a this is what is exemplified (valve seat inserts and crankshaft for an engine).	
comprising:	Comprising - must contain at least the following features but may include more (Virgin v Premium)	1
heating the steel component in a treatment atmosphere to an elevated temperature for a period of time sufficient to form a modified layer on the surface of the steel component;	Heating - increasing the temperature Steel component – as defined above Treatment atmosphere – the gaseous surroundings which modify the surface as this is what is understood by the skilled person and is consistent with Fig. 1. Suggests in an enclosed space, e.g. a furnace as exemplified. Elevated temperature – the temperature is not defined here but elevated means it is above room temperature. The purpose of heating is so the carbon-containing gas and nitrogen-containing gas dissociate therefore the temperature must be high enough so gases can dissociate. The repercussive effect of claim 2	1

	means it includes temperatures of no more than 900 Celsius but is broader than this so can be above 900 Celsius. For a period of time – there is no indication of how long this should be but must be long enough so the modified layer forms. Sufficient to form a modified layer on the surface of the steel component – limits the minimum amount of time can be heated. Must be heated long enough so that a modified layer is formed on the surface of the steel component Modified layer – also described as the 'case' (page 5, lines 5-6). 1 Modified layer – a hardened layer on the outer surface of the steel
wherein the treatment atmosphere comprises:	Treatment atmosphere – as defined above

	Comprises - must contain at least the following features but may include more (Virgin v Premium)
a carbon-containing gas suitable for creating a carbon-enriched layer on the surface of the steel component; and	The carbon-containing gas shall include endothermic gas but be broader than this as claim 3 limits to endothermic gas and a dependent claim narrows the scope (repercussive effect). Suitable for – must be able to create a carbon-enriched layer on the surface of the steel component Carbon-enriched – the carbon content is higher than the steel component (page 4, line 21). Layer- on the outer surface of the steel component The carbon-containing gas must be able to provide the carburizing (page 5, lines 19-20).

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a nitrogen-containing gas suitable for creating a nitrogen-enriched layer on the surface of the steel component.	Nitrogen-containing gas – does this mean it has to be nitrogen-rich? Nitrogen-rich – a gas that dissociates to provide nitrogen atoms at the surface of the component (page 5, lines 25-26). Nitrogen-containing gas shall be construed as a gas that dissociates to provide nitrogen atoms. Nitrogen (N_2) does not dissociate into nitrogen atoms at the temperatures used in heat treating steel and so nitrogen-containing gas shall not include nitrogen as cannot perform the function of carbonitriding (page 5, lines 27-29). The nitrogen-containing gas shall include ammonia but be broader than this as claim 3 limits to ammonia and a dependent claim narrows the scope (repercussive effect).

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	The nitrogen-containing gas must be able to perform the carbonitriding (page 5, line 22). Nitrogen-enriched – the nitrogen content is higher than the steel Layer – can this be the same as the carbon-enriched layer? The patent describes a carburized case and a nitrogen-rich case (page 6, lines 4-5) however the claim is not limited to a 2 step process where the carbon-containing gas is introduced first therefore shall also include the case where the carbon-enriched layer and nitrogen-enriched layer is the same layer The carbon-enriched layer and nitrogen-enriched layer can be the same or separate layers.

The direct product of the process of claim 1 has either a single layer which is carbon and nitrogen-enriched or one layer which is carbon-enriched and a second layer which is nitrogen-enriched.

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Claim 2

A method as claimed in claim 1,	Must include all the features of claim 1 and…
wherein the elevated temperature is no more than 900 Celsius.	Is this for the whole period or just after all the gases are introduced? Claim 1 is not limited to a 2-step process therefore shall be interpreted in that there is a period of time where the steel component is heated to no more than 900 Celsius, however, this shall not mean that there cannot be another period of time where the temperature is more than 900 Celsius. No more than 900 means it can be 900 Celsius or less. Not limiting to the whole process being carried out at no more than 900 Celsius also means the claim does not exclude the examples (page 6, line 28) and so that claim 5 which is dependent on claim 2 is not outside the scope of claim 2 as the first step is conducted at 900-955 Celsius.

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	No more than 900 – limits the maximum temperature but puts no limit on the lower temperature

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Claim 3

A method as claimed in claim 1 or 2,	Must include all the features of claim 1 or claim 1+2 and…
wherein the carbon-containing gas is endothermic gas,	Carbon-containing gas – as construed for claim 1 'endothermic gas' – produced by incomplete combustion of hydrocarbons in air, such as natural gas (methane) or propane (page 4, lines 28-29) as this is what is described in the patent.
and the nitrogen-containing gas is ammonia.	Nitrogen-containing gas – as construed for claim 1 Ammonia = NH_3

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Claim 4

A method as claimed in claim 3,	Must include all the features of claim 1+3 or claim 1+2+3 and…
wherein the treatment atmosphere contains up to 11% by volume ammonia,	Treatment atmosphere – as construed for claim 1 The total volume of the treatment atmosphere is up to 11% ammonia – this is clear to the skilled person
the balance being endothermic gas.	Balance – shall be the remaining volume of the treatment atmosphere The treatment atmosphere therefore contains up to 11% by volume ammonia and the remaining volume is endothermic gas.

Claim 5

A method as claimed in any preceding claim comprising:	Must include all the features of claims 1, 1+2, 1+3, 1+2+3, 1+3+4 or 1+2+3+4 and… Dependencies = +1
heating the steel component in the carbon-containing gas at a temperature of 900–955 Celsius for a first period;	heating the steel component in the carbon-containing gas – the temperature of the steel component is

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	increased when in the carbon-containing gas 900-955 Celsius – shall include rounding errors – 899.5-955.4 Celsius The period of time required for the heat treatment step depends on the size of the steel component (page 7, lines 5-6). First period shall include about 2 hours as this is what is exemplified (page 6, line 30). Shall also include approximately 3 hours as this is what is exemplified for the crankshaft – 50% longer (page 7, lines 5-7). The period must be long enough so that carburizing occurs (page 5, lines 19-20) to provide a carburized case (page 6, lines 4-5).	1
introducing the nitrogen-containing gas; and	The nitrogen-containing gas is added so there is now carbon-containing gas and nitrogen-containing gas present.	

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	The nitrogen-containing gas is not present during the first period of heating. The nitrogen-containing gas is as construed for claim 1.
heating the steel component in the treatment atmosphere including the nitrogen-containing gas at a temperature of about 850 Celsius for a second period.	The treatment atmosphere contains the carbon-containing gas and the nitrogen-containing gas. About 850 Celsius – the use of the term 'about' means the temperature is not exactly 850 but shall include temperature either side – seems reasonable to include 840-860 Celsius. The temperature must be sufficient to dissociate the ammonia to provide nitrogen atoms for adsorption onto the metal surface while maintaining a carburization effect from the endothermic gas (page 6, lines 1-3). Second period shall include up to 3 hours as this is what is exemplified (page 6, lines 34-35).

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	Shall also include up to approximately 4.5 hours as this is what is exemplified for the crankshaft (page 7, lines 5-7). The period must be long enough so that carbonitriding occurs (page 5, lines 20-22) to provide a nitrogen-rich case (page 6, lines 5-6).

The direct product of the process of claim 5 has a carbonized case on the steel component and a carbonitride case on top (page 6, lines 4-6).

MARKS AWARDED: 14

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Infringement

The Gastride mode does not infringe the claims as there is no carbon-containing gas present which provides a carbon-rich layer

Gastride Plus:

Claim 1

A method of heat treating a steel component,	Uses a steel nitriding furnace to provide case hardening (page 10, lines 2-4). The method includes using a furnace to heat the steel and imparts a thin carbonitride layer (page 10, lines 19-21) therefore the method modifies the surface and heat treats a steel component. FEATURE DISCLOSED	1
comprising:	-	
heating the steel component in a treatment atmosphere to an elevated temperature for a period of time sufficient to form a modified layer on the surface of the steel component;	Carried out in a furnace so treatment atmosphere refers to the gases in the furnace. The furnace temperature can be set to 560-720 Celsius (above room temperature) (page 10, lines 20-21)	1

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	therefore the steel component is heated to an elevated temperature. The temperature is high enough that carbonitriding (described as nitrocarburising in Doc B) occurs therefore assume that the gases dissociate (page 10, line 19). The treatment atmosphere in Doc B contains both ammonia and endothermic gas as this is what is fed into the furnace (page 10, lines 17-18). The process is carried out for 30 minutes – 5 hours (page 10, line 18). This is described as long enough to impart a thin carbonitirde layer on a nitride 'diffusion' zone' (page 10, line 20). Therefore heated for a period of time. A carbonitride layer is formed (page 10m line 20) therefore sufficient to form a modified layer. This layer increases the strength of the

	crankshaft over 150% (page 11, lines 13) therefore provides a hardened layer. FEATURE DISCLOSED	
wherein the treatment atmosphere comprises:	The treatment atmosphere contains ammonia and endothermic gas (page 10, lines 17-18). FEATURE DISCLOSED	
a carbon-containing gas suitable for creating a carbon-enriched layer on the surface of the steel component; and	Contains an endothermic gas (page 10, line 18) which is a carbon-containing gas as construed. Forms a carbonitride layer which is a carbon-enriched layer (page 10, line 20) on the surface of the steel. FEATURE DISCLOSED	1
a nitrogen-containing gas suitable for creating a nitrogen-enriched layer on the surface of the steel component.	Contains ammonia gas (page 10, line 17) which is a nitrogen-containing gas as construed. Forms a carbonitride layer which is a nitrogen-enriched layer (page 10, line 20) on the surface of the steel.	1

	As construed the carbon-enriched layer and nitrogen-enriched layer can be the same layer which is the case here. FEATURE DISCLOSED

The Gastride Plus process discloses all the features of claim 1 therefore claim 1 is infringed by the Gastride Plus process.

The crankshaft treated using this method shall also infringe as a direct product of the process (as long as it is not treated further so it materially changes).

Claim 2

A method as claimed in claim 1,	Yes FEATURE DISCLOSED
wherein the elevated temperature is no more than 900 Celsius.	The furnace temperature control is set to 560-720 Celsius (page 10, line 21). this is less than 900 Celsius. FEATURE DISCLOSED

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The Gastride Plus process discloses all the features of claim 2 therefore claim 2 is infringed by the Gastride Plus process.

The crankshaft treated using this method shall also infringe as a direct product of the process (as long as it is not treated further so it materially changes).

Claim 3

A method as claimed in claim 1 or 2,	Yes FEATURE DISCLOSED
wherein the carbon-containing gas is endothermic gas,	Endothermic gas is used (page 10, line 18). FEATURE DISCLOSED
and the nitrogen-containing gas is ammonia.	Ammonia is used (page 10, line 17). FEATURE DISCLOSED

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The Gastride Plus process discloses all the features of claim 3 therefore claim 3 is infringed by the Gastride Plus process.

The crankshaft treated using this method shall also infringe as a direct product of

Claim 4

A method as claimed in claim 3,	Yes FEATURE DISCLOSED
wherein the treatment atmosphere contains up to 11% by volume ammonia,	The example gas mixtures contain 50% volume ammonia (page 10, lines 25-26). This is more than 11% by volume ammonia. FEATURE NOT DISCLOSED

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the balance being endothermic gas.	In the first standard gas mixture the remaining gas is endothermic gas page 10, line 25). FEATURE DISCLOSED In the second standard gas mixture there is also air present therefore the balance gas is not all endothermic gas – therefore the balance is not endothermic gas.

The Gastride Plus process does not disclose a treatment atmosphere containing up to 11% by volume ammonia therefore claim 4 is not infringed.

The crankshaft treated using this method shall also not infringe claim 4.

Doc B describes that the system allows complete control of gases and temperature therefore customised treatments can be developed (page 10, lines 30-33) therefore possible that they could be infringing claim 4 – difficult to check.

Claim 5

A method as claimed in any preceding claim comprising:	Yes for claim 1-3 No for claim 4
heating the steel component in the carbon-containing gas at a temperature of 900–955 Celsius for a first period;	The steel component is heated at 560-720 Celsius (outside the range) although it is described that the control system allows complete

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	control of temperature therefore there is the possibility of using higher temperatures. FEATURE NOT DISCLOSED	
introducing the nitrogen-containing gas; and	The ammonia gas is present from the start of the process. There is not a step where there is just carbon-containing gas followed by the addition of nitrogen-containing gas. FEATURE NOT DISCLOSED	1
heating the steel component in the treatment atmosphere including the nitrogen-containing gas at a temperature of about 850 Celsius for a second period.	Heated at 560-720 Celsius (page 10, line 21). This is not 'about' 850 Celsius. FEATURE NOT DISCLOSED	1

The Gastride Plus process does not disclose a two-step heat treatment process therefore claim 5 is not infringed.

The crankshaft treated using this method shall also not infringe claim 5.

MARKS AWARDED: 10

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Novelty

Case hardening (page 4, lines 14-20) is prior art for novelty and inventive step as has been used for many years (before the filing of Doc A). The claims do not lack novelty over case hardening as case hardening involved only heating and controlling in a controlled manner. There is no nitrogen-containing gas nor carbon-containing gas present.

Carburizing is also prior art for novelty and inventive step as has been available in the UK for nearly 100 years (page 2, lines 4-6). Carburizing is described on page 4, line 20 to page 5, lines 11.

Doc C was published in 1980 which is prior to the filing date of Doc A therefore it is prior art for novelty and inventive step. 1

Claim 1

	Carburizing	**Doc C**
A method of heat treating a steel component,	A modified heat treatment where the carbon content of the steel surface is raised (page 4, lines 20-21). Therefore a method of heat treating a steel component. FEATURE DISCLOSED	Heat treatment process (see title). Steels with a carbon range of 0.30 to 0.50% can be carbonitrided (page 12, line 19). The process therefore involves using heat

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		to modify the surface of steel. FEATURE DISCLOSED	
comprising:	-	-	
heating the steel component in a treatment atmosphere to an elevated temperature for a period of time sufficient to form a modified layer on the surface of the steel component;	The furnace is heated to 900-950 Celsius (page 5, line 2) for up to 6 hours which results in a modified surface layer (page 5, lines 4-6). Heated so the carbon atoms, mainly from the breakdown of carbon monoxide diffuse and adsorb onto the metal near the surface (page 5, lines 3-4). Therefore heated high enough so the gas dissociates and long enough so that a modified surface layer is produced. FEATURE DISCLOSED	Modified form of gas carburising (page 12, line 2) therefore involves heating in a treatment atmosphere to form a modified surface FEATURE DISCLOSED	1 1

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wherein the treatment atmosphere comprises:	-	-	
a carbon-containing gas suitable for creating a carbon-enriched layer on the surface of the steel component; and	Carbon-rich environment that provides carbon atoms which adsorb onto the steel surface (page 4, line 24). The carbon-rich environment can be a gas that dissociates to provide carbon atoms (page 4, lines 25-26). Endothermic gas has been used (page 4, line 28) which is a carbon-containing gas as construed. The carbon content of the steel surface is raised during heat treatment (page 4, lines 20-21).	There is a gas-carburizing atmosphere (page 12, lines 3-4) therefore there is a carbon-containing gas as provides the carburizing. Carbonitrided case layer contains both carbon and nitrogen (page 12, lines 11-12). There is therefore a carbon-enriched layer as can be the same as the nitrogen-enriched layer. FEATURE DISCLOSED	1 1

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	Carbon atoms diffuse and adsorb onto the metal near the surface and results in a modified layer (page 5, lines 3-4). The modified layer is formed from carbon atoms therefore a carbon-enriched layer is formed. FEATURE DISCLOSED		
a nitrogen-containing gas suitable for creating a nitrogen-enriched layer on the surface of the steel component.	The example gas composition contains nitrogen (page 4, line 31) however this is not a nitrogen-containing gas as construed. No other mention of nitrogen-containing gas. FEATURE NOT DISCLOSED	Ammonia is introduced into the gas carburizing atmosphere (page 12, lines 3-4) therefore there is a nitrogen-containing gas. Adds nitrogen to the carburised surface case layer as it is being produced (page 12, lines 4-5).	1 1

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		Nitrogen forms by the dissociation of ammonia in the furnace atmosphere (page 21, lines 5-6). Carbonitrided case layer contains both carbon and nitrogen (page 12, lines 11-12). There is therefore a nitrogen-enriched layer as can be the same as the carbon-enriched layer. FEATURE DISCLOSED

Claim 1 does not lack novelty over the carburizing process as there is no mention of the use of a nitrogen-containing gas.

Claim 1 appears to lack novelty over Doc C as all features are disclosed.

Claim 2

	Carburizing	**Doc C**

A method as claimed in claim 1,	No FEATURE NOT DISCLOSED	Yes FEATURE DISCLOSED
wherein the elevated temperature is no more than 900 Celsius.	Heated to 900-950 Celsius (page 5, line 2). Heating to 900 would be in the scope of this claim as can be 900 Celsius. FEATURE DISCLOSED	No temperatures are disclosed in Doc C. FEATURE NOT DISCLOSED

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Claim 2 does not lack novelty over the carburizing process due to its dependency on claim 1.

Claim 2 does not lack novelty over Doc C as Doc C does not disclose any temperatures.

Claim 3

	Carburizing	**Doc C**
A method as claimed in claim 1 or 2,	No FEATURE NOT DISCLOSED	Yes – claim 1 No – claim 2
wherein the carbon-containing gas is endothermic gas,	Endothermic gas has been used (page 4, line 28). FEATURE DISCLOSED	The nature of the gas carburizing

		atmosphere is not disclosed. FEATURE NOT DISCLOSED
and the nitrogen-containing gas is ammonia.	No mention of ammonia FEATURE NOT DISCLOSED	Ammonia is introduced into the gas carburizing atmosphere (page 12, lines 3-4). FEATURE DISCLOSED

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Claim 3 does not lack novelty over the carburizing process due to its dependency on claim 1 and because the process does not use ammonia.

Claim 3 does not lack novelty over Doc C as Doc C does not describe the nature of the carbon-containing gas.

Claim 4

	Carburizing	**Doc C**
A method as claimed in claim 3,	No FEATURE NOT DISCLOSED	No FEATURE NOT DISCLOSED

wherein the treatment atmosphere contains up to 11% by volume ammonia,	No mention of ammonia in the carburizing process FEATURE NOT DISCLOSED	There is no mention of the amount of ammonia used. FEATURE NOT DISCLOSED
the balance being endothermic gas.	-	The composition of the treatment atmosphere is not disclosed. FEATURE NOT DISCLOSED

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Claim 4 does not lack novelty over the carburizing process due to its dependency on claim 1 and because the process does not use ammonia.

Claim 4 does not lack novelty over Doc C as the composition of the treatment atmosphere is not disclosed and also because of its dependency on claim 3.

Claim 5

	Carburizing	**Doc C**
A method as claimed in any preceding claim comprising:	No FEATURE NOT DISCLOSED	Yes – claim 1 No – claims 2, 3 and 4

heating the steel component in the carbon-containing gas at a temperature of 900–955 Celsius for a first period;	The steel component is heated at 900-950 Celsius in a furnace with endothermic gas (page 5, lines 1-2) which is a carbon-containing gas. Heated for up to 6 hours which results in a modified surface layer (page 5, line 5) which is a first period. FEATURE DISCLOSED	The temperatures used in the process are not disclosed. FEATURE NOT DISCLOSED	1 1
introducing the nitrogen-containing gas; and	There is no nitrogen-containing gas in the carburising process. FEATURE NOT DISCLOSED	It appears that the ammonia is present from the start as the steel only contains a single layer (page 12, lines 24-25). FEATURE NOT DISCLOSED	1 1
heating the steel component in the treatment atmosphere including the nitrogen-	There is no second step where nitrogen-containing gas is added.	Ammonia is present from the start, it is not a 2 step process	1

containing gas at a temperature of about 850 Celsius for a second period.	FEATURE NOT DISCLOSED	and no temperatures are disclosed. FEATURE NOT DISCLOSED

Claim 5 does not lack novelty over the carburizing process due to its dependency on the previous claim and also because it does not disclose a second step which uses a nitrogen-containing gas.

Claim 5 does not lack novelty over Doc C as Doc C does not disclose a 2-step process. Also when dependent on claims 2-4 does not disclose these features.

MARKS AWARDED: 20

Examiner's use only

Inventive step

Use Pozzoli approach and consider at priority date of patent (6 March 2019).

The skilled person is a provider of heat treatment services. 1/2

Gas carburization is part of the common general knowledge (cgk) as it is described as well-known and widely available in the UK for nearly 100 years (page 2, lines 4-6 and page 4, line 14 to page 5, line 11).

Heat treatment of steel components is part of the cgk as described as well known (page 4, lines 11-13). It is known and part of the cgk that by submitting the component to heating and cooling, the crystal structure of the steel can be changed into forms that are stronger or tougher. 1

Is C part of the cgk as published in 1980 which was a long time ago? Going to assume not as not described as being well known by either the client or Ferrocase.

Claim 1

The inventive concept of claim 1 is reducing the need for post-treatment machining or grinding (page 5, lines 12-13) by the addition of a nitrogen-rich gas to produce a shallower but harder case which avoids distortion (page 5, lines 14-18). 1

Take Doc C as the state of the art as also concerned with carbonitriding heat treatment. From my construction above claim 1 appears to lack novelty. Even if the carbon-enriched layer must be different to the nitrogen-rich layer, Doc C teaches that the hardenability of the case is significantly greater when nitrogen is added by carbonitriding than when the same steel is only carburized (page 12, 1

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lines 24-26). Doc C also teaches that because lower processing temperatures can be used there may be less distortion and better control of dimensions than carburizing which may eliminate the need for straightening or final grinding operations (page 12, lines 30-33).

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Therefore even if claim 1 does not lack novelty the inventive concept of claim 1 is disclosed in Doc C therefore claim 1 would appear to lack inventive step.

Claim 2

The inventive concept of claim 2 is using a maximum temperature to ensure the nitrogen-containing gas dissociates for adsorption onto the metal while maintaining a carburization effect from the carbon-containing gas (page 6, lines 1-3).

Doc C shall be taken as the state of the art as it is also concerned with a carbonitriding heat treatment process. Doc C differs in that the temperature of the process if not disclosed in Doc C. Doc C does however disclose that carbonitriding can be carried out at a lower temperature than regular gas carburising (page 12, lines 7-8). Therefore this provides motivation for the skilled person to try lower temperatures than carburisation which is part of the cgk and could be considered routine experimentation. It therefore appears that it would be obvious to reduce the temperature and claim 2 lacks inventive step.

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You may be able to argue that the skilled person would not consider using these temperatures however this appears to be a weak argument as Doc C provides motivation to use lower temperatures.

Claim 3

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The inventive concept of claim 3 is the use of ammonia and an endothermic gas. The ammonia dissociates into nitrogen and hydrogen at temperatures used in heat treating steel (page 5, lines 26-27). 1 1/2

Doc C shall be taken as the state of the art as it is also concerned with a carbonitriding heat treatment process. Doc C differs in that it does not disclose the nature of the carbon-containing gas. However, the carburizing process which is part of the cgk uses endothermic gas therefore it would be obvious to the person skilled in the art to use an endothermic gas as the carbon-containing gas. Claim 3 therefore appears to lack inventive step. 1

Claim 4

The inventive concept of claim 4 is to ensure the surface properties are consistent by not using more than 11% ammonia by volume (page 5, lines 30-32). 1

Doc C shall be taken as the state of the art as it is also concerned with a carbonitriding heat treatment process. Doc C does not disclose the amount of ammonia used in the process and there is no suggestion that there are advantages associated with using specific amounts of ammonia. There is no motivation in Doc C or the cgk to use up to 11% by volume ammonia. Claim 4 therefore appears to be inventive. 1 1

Claim 5

The inventive concept of claim 5 is the use of a two step process to provide a case layer produced by carburizing which is further hardened by carbonitriding (page 6, lines 7-9).

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Doc C shall be taken as the state of the art as it is also concerned with a carbonitriding heat treatment process. Doc C does not describe a two-step process but a process where the nitrogen-containing gas and carbon-containing gas are present at the start so the resulting structure is a single layer. There is no mention in doc C that the process can be separated out into two-steps or that there are any advantages associated with having a carburized layer and a carbonitrided layer. There is also no motivation in the cgk as there is no carbontriding. Claim 5 therefore appears to be inventive as it would not be obvious to use a 2-step process.

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Should check the above arguments with a skilled person to see if they agree with my conclusions.

MARKS AWARDED: 11

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Sufficiency

There appears to be some sufficiency issues with the claims.

In your letter you mention that the temperature of the second stage of the process must be between 800 and 850 Celsius as above 850 Celsius the ammonia dissociates into nitrogen and hydrogen in the furnace which prevents a proper case layer from forming and below 800 Celsius the temperature is insufficient to provide carburization (page 2, lines 17-22). Furthermore, you state that outside these temperatures, results become highly unpredictable and from time to time fail (page 2, lines 22-24). 1 1

Therefore the temperature range 800-850 appears to be an essential feature of the invention and outside of this temperature range the invention cannot be worked. The claims therefore appear to be insufficient as the invention does not work across the whole scope of the claim. Would it be easy for the skilled person to determine this temperature range, e.g. routine experimentation? Or would it require more, e.g. a research project.

There is no basis in the patent for the range 800-855. There is basis for 815-900 Celsius (page 5, line 38) or around 850 Celsius (page 6, line 1).

Currently only claim 5 is limited to a two-step process and this includes a temperature limitation of 850 Celsius for the second stage therefore claim 5 appears to be sufficient for this feature.

There are currently no temperature limitations in claim 1 and it is not limited to a two-step process, the nitrogen-containing gas may be present for the whole process.

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The infringement uses a temperature range of 560-720 Celsius and ammonia and endothermic gas are added at the same time therefore ideally do not want to limit to claim 5 as this would not catch the infringement.

If the process is a single step process are these temperatures still necessary or can it be worked over a broader temperature range? If not, how does the Gastride Plus process work?

The patent can be revoked for lack of sufficiency therefore need to ensure we can either make suitable amendments or arguments to overcome any insufficiency objections.

You also mention that you need to ensure that the component is at the lower temperature when the second stage starts and because of the larger thermal mass of a crankshaft it can take up to 30 minutes from dropping the furnace temperature until the temperature reaches equilibrium (page 2, lines 26-28). You indicate this is relatively easy to determine with a few practical tests (page 2, lines 28-29). This suggests that there is no undue burden for the skilled person to work the invention. I think we can therefore argue that the claim does not lack sufficiency as the skilled person can easily determine how to work the invention. Furthermore, is the problem only found with the crankshaft due to its larger size? The claim is not limited to a specific steel component.

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MARKS AWARDED: 4

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Examiner's use only

Amendments

Want to amend the claims so they are novel, inventive and infringed and also to address any sufficiency objections (discussed above).

From my analysis above it appears that claims 1-3 lack novelty/inventive step but claims 4 and 5 are novel and inventive.

From my analysis claims 1-3 are infringed. There does not therefore appear to be a claim which is novel, inventive and infringed.

Therefore turn to the description for amendments. Could include a limitation on the nitrogen-enriched layer depth of 0.07 mm-0.75 mm (page 6, line 6) as this covers the infringement (page 10, line 29) but might not be novel/inventive over Doc C (page 12, line 20). 1

Claim 2 is also arguably inventive and is infringed therefore limiting the elevated temperature in claim 1 to no more than 900 Celsius could be an option.

MARKS AWARDED: 1

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Advice

Carbotreat = CT

Ferrocase = FC

The patent is granted and renewal fees are not yet due (31 March 2023) therefore in force and immediately enforceable.

The improved carburizing process using ammonia is CT's main service and losing customers to FC therefore want to stop FC.

From my analysis it appears that claims 1-3 lack novelty/inventive step but claims 4 and 5 are novel and inventive and claims 1-3 are infringed.

FC are infringing by using/offering to use the process.

Therefore I recommend amending the patent to try and a get a valid and infringed patent. As FC are already infringing I recommend brining infringement proceedings and amending under s75. It is possible to amend before beginning infringement proceedings however this will delay proceedings as have to advertise and give the opportunity for opposing the amendment. Note that FC can also oppose the amendment under s75.

Send a letter before action but unlikely to be able to settle. It would be advantageous to avoid infringement proceedings as costly and lengthy.

Remedies include damages/account of profits, delivery up/destroy, declaration of validity and infringement, costs and injunction.

Could also consider getting a UKIPO opinion on infringement but could result in FC bringing revocation proceedings.

Examiner's use only

Should send a copy of the patent to FC so they do not have a defence of innocent infringement which prevents damages being available. 1

As FC have already started offering their process an interim injunction does not appear appropriate. 1

It is also an infringement to use, dispose, offer, import or keep a direct product of the process. Therefore the UK engine manufacturer are also infringing the patent as FC are making the hardened crankshaft for them and this is therefore a direct product of the process.

For a new product the burden of proof is on the infringer to prove that it was not made using a process which infringes (reverse burden of proof).

The UK engine manufacturer are a potential client for CT therefore do not necessarily want to bring infringement proceedings against them.

Could make them aware of the patent (be careful not to threaten) and offer to use the process for them instead. Does their contract with FC allow them to break the contract early? 1

FC's article was published in March 2022 which was after the grant of Doc A, however, FC were approached in early 2019 by a client to make an existing crankshaft much stronger. Was this prior to the filing of Doc A? If so, did they make serious and effective preparations to use the process. They modified their earlier process Gastride, would this have been easy and taken long? If so then they will have prior user rights if this was in good faith. 1 1

Check to see if FVC have any patents/applications which affect your freedom to operate. If so then consider prior art search to revoke or cross licensing.

MARKS AWARDED: 5

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