(12) UK Patent Application (19) GB (11) 2 394 523 (13) A

(43) Date of A Publication 28.04.2004

(21) Application No: 0224717.9

(22) Date of Filing: 24.10.2002

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(51) INT CL^7:
F16C 1/06 , F01D 25/36

(52) UK CL (Edition W):
F2Q Q8

(56) Documents Cited:
GB 2266354 A
GB 1415053 A
SU 000754925 A
US 5022876 A
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(58) Field of Search:
UK CL (Edition V) **F2Q**
INT CL^7 **F01D, F16C**
Other: **Online: WPI, JAPIO & EPODOC**

(54) Abstract Title: **Drive assembly having an elongate member**

(57) A drive assembly 30 comprises drive means 31 for providing a driving force, and engagement mechanism 34 for further driving an article, preferably the compressor 14 of a gas turbine 10. The assembly 30 further includes an elongate member 35 extending between the drive means 31 and the engagement mechanism 34, and transmission means 36 extending along the elongate member 35 to transmit the driving force from the drive means 31 to the engagement mechanism 34. The engagement mechanism 34 is preferably a belt 42 which in use drives the compressor, through friction, to allow the inspection of the compressor blades. The drive means 31 may be a motor. The elongate member may be flexible.

Fig.1.

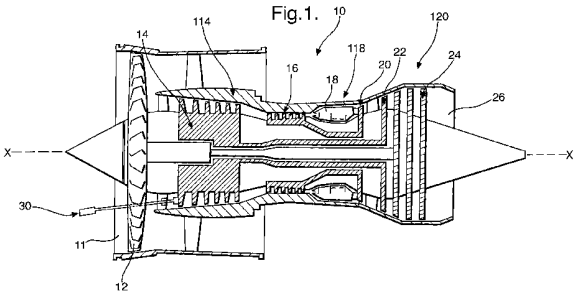

Fig.2.

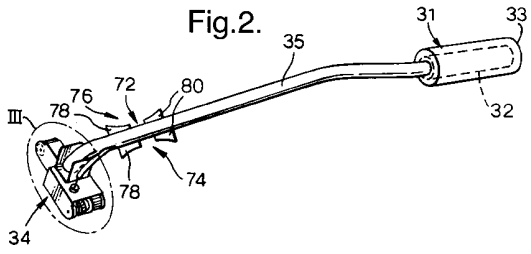

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Fig.1.

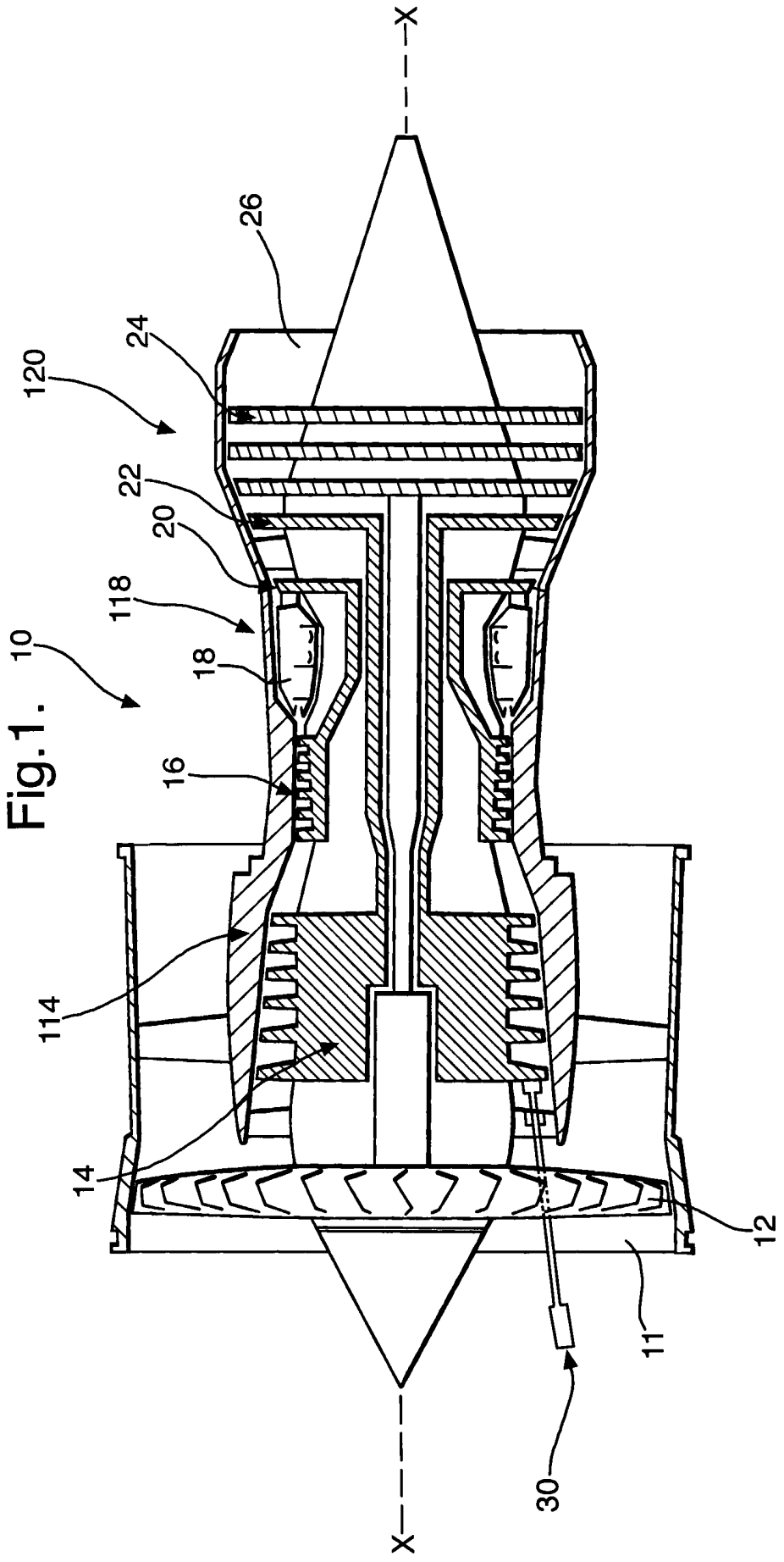


Fig.2.

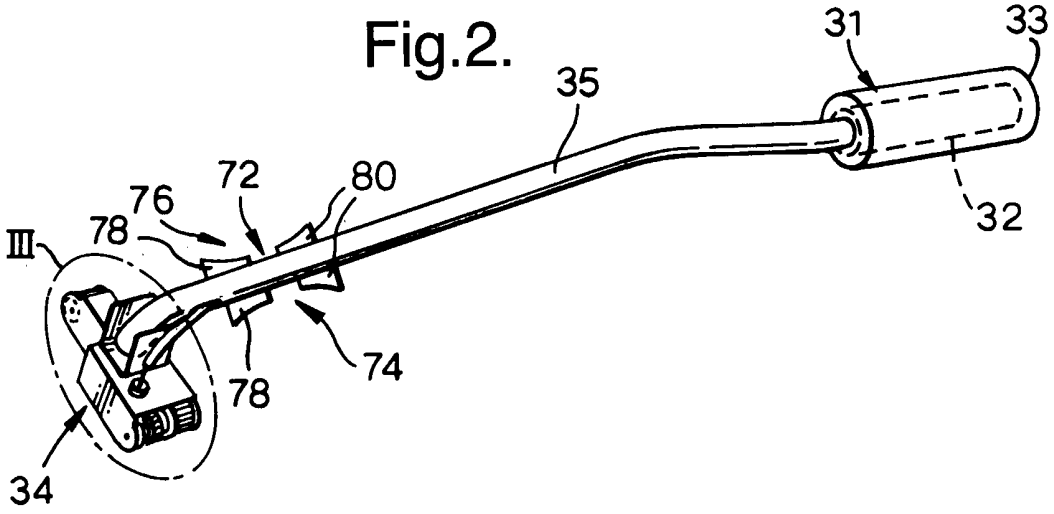


Fig.3.

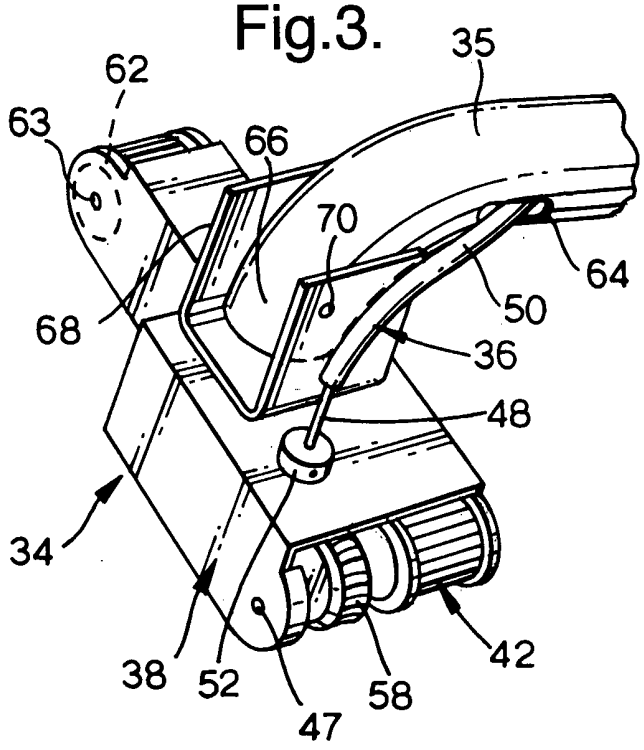
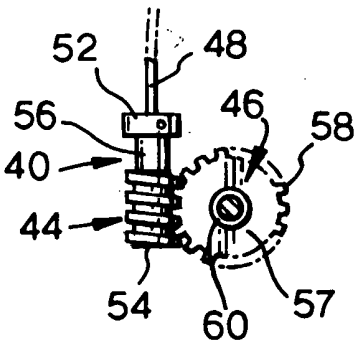


Fig.4.



Drive Assembly

This invention relates to drive assemblies. More particularly, but not exclusively, the invention relates to drive assemblies for use with gas turbine engines, for example to drive a rotary component of a gas turbine engine, such as intermediate pressure compressor.

During the servicing of gas turbine engines, it can be necessary to inspect the compressors and turbines. This requires the intermediate compressor to be rotated by hand or by using a rod or a stick to rotate the compressor.

According to one aspect of this invention there is provided a drive assembly comprising drive means for providing a driving force, an engagement mechanism for drivingly engaging an article, an elongate member extending between the drive means and the engagement mechanism, and transmission means extending along the elongate member to transmit the driving means extending along the elongate member to transmit the driving force from the drive means to the engagement mechanism to drive the article.

Preferably the drive means comprises a motor, which may be an electric motor. Control means may be provided to control the drive means. The control means may be provided on the drive means, or may be remote therefrom.

A casing may be provided to hold the drive means therein. The casing is preferably substantially cylindrical.

The transmission means may be flexible and may extend through the elongate member. In one embodiment, the transmission means comprises an elongate transmission element such as a cable. The transmission means may include a sleeve provided around the elongate transmission elements. The sleeve may comprise a housing through which the elongate transmission element extends. The sleeve may comprise a cable housing and extend the length of the

elongate transmission element.

The engagement mechanism may comprise a gear assembly and may also include a movable engagement member engageable with the article, wherein the engagement member can be driven by the drive means.

The gear assembly may comprise a worm gear arrangement. The worm gear arrangement may comprise a worm gear to which the transmission means may be connected. The worm gear arrangement may comprise a driving wheel in driving engagement with the worm gear. The wheel is preferably a toothed wheel or a pulley.

The engagement member may be mounted on the wheel. A second wheel may be provided and the engagement member may extend around the driving wheel and the second wheel.

The engagement member may be flexible. Preferably, the engagement member comprises a track member which is conveniently endless. The engagement member conveniently has a surface to drive the article by friction engagement therewith.

The elongate member may be hollow and preferably comprises a tubular member. The drive means is preferably provided at a first end of the elongate member and the engagement mechanism is preferably provided at a second opposite end of the elongate member.

The engagement mechanism may be pivotally attached to the elongate member.

Clamping means may be provided to clamp the drive assembly to an article. The clamping means may comprise a first pair of clamping members to clampingly engage an object, which may be part of the article and may also include a second pair of clamping members to clampingly engage a second part of the article. The first and second pairs of clamping members are preferably arranged opposite each other.

The clamping members may be formed of a plastics material, for example, nylon. The clamping members may be

movable to engage an object. Preferably, the clamping members are mounted on the elongate member and may be slidable along the elongate member into engagement with the object.

The preferred embodiment of this invention is particularly suitable for use in turning an intermediate compressor of a gas turbine engine, for example during inspection. With the preferred embodiment, the engagement mechanism can be inserted from the front of the engine through the fan and the inlet guide vanes until the engagement member engages the intermediate compressor. The preferred embodiment of the device can be clamped to the inlet guide vanes by the clamping means. Operation of the drive means of the preferred embodiment to drive the engaging member drives the intermediate compressor causing it to turn.

An embodiment of the invention will now be described by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic sectional side view of a gas turbine engine showing a drive assembly in use;

Fig. 2 shows a drive assembly;

Fig. 3 is a close up of the region marked III in Fig. 2; and

Fig. 4 is a view of a gear assembly used in the engagement mechanism of the drive assembly shown in Fig. 2.

With reference to Fig. 1, a ducted fan gas turbine engine generally indicated at 10 has a principal axis X-X. The engine 10 comprises, in axial flow series, an air intake 11, a propulsive fan 12, a compressor region 114 comprising an intermediate pressure compressor 14, and a high pressure compressor 16, combustion means 118 comprising a combustion 18, and a turbine region 120 comprising a high pressure turbine 20, an intermediate pressure turbine 22, and a low pressure turbine 24. An exhaust nozzle 26 is provided at the tail of the engine 10.

The gas turbine engine 10 works in the conventional manner so that air entering the intake 11 is accelerated by the fan to produce two air flows: a first air flow into the intermediate pressure compressor 14 and a second air flow which provides propulsive thrust. The intermediate pressure compressor 14 compresses the air flow directed into it before delivering the air to the high pressure compressor 16 where further compression takes place.

The compressed air exhausted from the high pressure compressor 16 is directed into the combustion 18 where it is mixed with fuel and the mixture combusted. The resultant hot combustion products then expand through, and thereby drive the high, intermediate and low pressure turbine 20, 22 and 24 before being exhausted through the nozzle 26 to provide additional propulsive thrust. The high, intermediate and low pressure turbines 20, 22 and 24 respectively drive the high and intermediate pressure compressors 16 and 14 and the fan 12 by suitable interconnecting shafts 28.

During maintenance and service of the engine 10, it is often necessary to inspect the intermediate pressure compressor 14. For this purpose, a drive assembly 30 is provided to turn the intermediate pressure compressor on its shaft about the axis X-X.

Referring to Figs. 2 to 4 of the drawings, there is shown the drive assembly 30, which comprises drive means 31 comprising an electric motor 32 held within a casing 33. The drive assembly 30 also includes an engagement mechanism 34 and a hollow elongate tubular shaft 35 extending from the drive means 31 to the engagement mechanism 34.

Transmission means in the form of an elongate cable arrangement 36 extends from the motor 32 to the engagement mechanism 34 through the hollow elongate shaft 35. The motor 32 provides a driving force which is transmitted by the cable arrangement 36 to the engagement mechanism 34.

Referring to Fig. 3, there is shown a close-up of the

engagement mechanism 34 which comprises a main body 38 in which is held a gear arrangement 40 (shown in more detail in Fig. 3), and a movable engagement member, in the form of a track member 42 driven by the motor 32.

The cable arrangement 36 comprises an inner cable 48 and a guide member which may be in the form of a cable housing 50 through which the inner cable 48 extends.

Referring to Fig. 4, the gear arrangement 40 comprises a worm gear 44 and a pulley or toothed wheel 46 arranged in meshing engagement with the worm gear 44. The worm gear 44 comprises a securing portion 52 and which is mounted on the main body 38, as shown in Fig. 3, and a meshing portion 54 which engages the toothed wheel 46. A neck portion 56 extends between the securing portion 52 and the meshing portion 54. The neck portion 56 is journalled in the main body 38 to allow rotation of the worm gear 44 about its main axis.

In use, spinning of the inner cable 48 about its longitudinal axis by the motor 32 causes corresponding rotary motion of the worm gear 44. The meshing portion 54 of the worm gear 44 is in meshing engagement with the toothed wheel 46. The toothed wheel 46 comprises a main part 57 having thereon teeth 58 for meshing with the meshing portion 54 of the worm gear 44. The toothed wheel 46 is rotatably mounted on the main body 38 by pins 47. The toothed wheel 46 also includes a central axially extending portion 60 which provides a rotary member around which the track member 42 extends.

The track member 42 extends from the toothed wheel 46 along the main body 38 to a further rotary member 62 which is rotatably mounted on the main body 38 by pins 63 at the opposite end thereof to the gear arrangement 40. Thus by operating the motor 32, to provide a rotary force to the inner cable about its axis, the meshing portion 54 of the worm gear 44 is caused to rotate to drive the toothed wheel 46, which in turn, drives the track member 42.

As can be seen, the cable arrangement 36 extends from the elongate member 35 via an aperture 64 defined therein. The elongate member 35 comprises a main portion 65 and an end portion 66 which is provided generally at right angles to the main portion 65. The end portion 60 is pivotally mounted to the main body 38 by a U-shaped mounting arrangement 68 and a pivot pin 70.

The track member 42 is formed of a material that will not damage the blades of the intermediate compressor 14. The track member 42 is in the form of an endless belt, which could be, for example, a timing belt.

The elongate shaft 35 is provided with clamping means 72 for clamping the drive assembly 30 to the variable inlet guide vanes of the gas turbine engine 10. The clamping means 72 comprises two pairs of clamping members 74, 76. Each pair of clamping members 74, 76 comprises a fixed clamping member 78 and a slidable clamping member 80 to allow the device to be securely fixed to the variable inlet guide vanes.

Referring back to Fig. 1, the use of the drive assembly 30 will now be described. In use, the drive assembly 30 is inserted by an inspector through the fan 12 of the gas turbine engine 10 such that the engagement portion 34 engages onto one of the blades of the intermediate pressure compressor 14. The clamping members 74, 76 are arranged to clamp the drive assembly 30 to the inlet guide vanes. In order to rotate the intermediate pressure compressor 14, the engagement mechanism 34 is arranged such that the track member 42 extends generally tangentially to the annulus of the intermediate pressure compressor 14 and the motor 32 can then be operated. The track member 42 is caused to rotate about the rotary members 42, 62 by the transmission of the driving force via the cable assembly 36 and the gear assembly 40 to the wheel 46. As a result, the drive assembly 36 rotates the intermediate pressure compressor 14 about a main axis. The

motor 32 can be controlled by control means (not shown) provided on the casing 33 or by remote control means.

In order to prevent the shaft 35 damaging the gas turbine engine 10 when the drive assembly 30 is inserted therein, the shaft 35 can be coated with a suitable shrink wrap plastics material to prevent metal to metal contact. The main body 38 of the engagement mechanism 34 can be coated with the same material, also to prevent metal to metal contact with the blades of the intermediate pressure compressor.

There is thus described a drive assembly which can be readily used to rotate the internal components of a gas turbine engine for inspection during maintenance.

Various modifications can be made without departing from the scope of the invention, for example, the elongate member need not be the exact shape as shown in the drawings.

Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

Claims:-

1. A drive assembly characterised by drive means for providing a driving force, an engagement mechanism for drivingly engaging an article, an elongate member extending between the drive means and the engagement mechanism, and transmission means extending along the elongate member to transmit the driving force from the drive means to the engagement mechanism to drive the article.

2. A drive assembly according to claim 1, wherein the drive means comprises a motor.

3. A drive assembly according to claim 2, wherein the assembly includes a casing to hold the drive means, the casing being substantially cylindrical.

4. A drive assembly according to any preceding claim wherein the transmission means is flexible and extends longitudinally through the elongate member.

5. A drive assembly according to claim 4, wherein the transmission means comprises an elongate transmission element.

6. A drive assembly according to claim 5, wherein the elongate transmission element comprises a cable and the transmission means further includes a cable housing extending substantially the length of the elongate member to guide the cable.

7. A drive assembly according to any preceding claim, wherein the engagement mechanism comprises a gear assembly and a movable engagement member engageable with the article, wherein the engagement member can be driven by the drive means.

8. A drive assembly according to claim 7, wherein the gear assembly comprises a worm gear arrangement comprising a worm gear to which the transmission means may be connected, and a driving wheel in driving engagement with the worm gear.

9. A drive assembly according to claim 8, wherein the

wheel is a toothed wheel or a pulley.

10. A drive assembly according to claims 8 or 9, wherein the engagement member is mounted on the wheel, and a second wheel is provided, wherein the engagement member extends around the driving wheel and the second wheel.

11. A drive assembly according to claims 7 to 10, wherein the engagement member is flexible.

12. A drive assembly according to claims 7 to 10, wherein the engagement member comprises an endless track member having a surface to drive the article by friction engagement therewith.

13. A drive assembly according to any preceding claim, wherein the elongate member is hollow and comprises a tubular member, the drive means being provided at a first end of the elongate member and the engagement mechanism being provided at a second opposite end of the elongate member.

14. A drive assembly according to claim 13, wherein the engagement mechanism is pivotally attached to the elongate member.

15. A drive assembly according to any preceding claim wherein the assembly further includes clamping means to clamp the drive assembly to an article.

16. A drive assembly according to claim 15, wherein the clamping means comprises a first pair of clamping members to clampingly engage a first region of the article and a second pair of clamping members to clampingly a engage a second region of the article, at least one clamping member of each of said first and second pairs of clamping members is movable along the elongate member to effect said clamping to the article.

17. A method of using a drive assembly according to any preceding claim, characterised by inserting the assembly into a gas turbine engine to engage a component thereof with the engagement mechanism operating the drive means to drive the engagement mechanism, thereby driving said

component.

18. A method according to claim 17, characterised by inserting the drive assembly into the gas turbine engine via the front of the engine to engage a rotary component of the engine.

19. A method according to claim 18, wherein the rotary component comprises an intermediate pressure compressor.

20. A method according to any of claims 17 to 19, wherein where the driving assembly includes clamping means, the method includes clamping the assembly to a further component of the engine.

21. A method according to claim 20, wherein the further component comprises an inlet guide vane of the engine.

22. A drive assembly substantially as herein described with reference to Figs. 1 to 3 of the accompanying drawings.

23. A method substantially as herein described with reference to Fig. 4 of the accompanying drawings.

24. Any novel subject matter or combination including novel subject matter disclosed herein, whether or not within the scope of or relating to the same invention as any of the preceding claims.

Application No: GB 0224717.9 **Examiner:** Jason Clee
Claims searched: 1 to 23 **Date of search:** 28 March 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1-6 & 13-15	US 5022876	(Etter, D. C.) especially see the abstract and figures
X	1, 4-7, 13 & 14	GB 1415053 A	(Svenska Kullagerfabriken AB) especially see the figures
X	1-6, 13 & 14	EP 1134059 A	(Bettcher Industries) especially see the abstract and figures
X	1-6, 13 & 14	US 5839961	(Stihl, A.) especially see the abstract and figures
A	-	GB 1594354 A	(Rolls-Royce Ltd)
A	-	SU 754925 A	(Pavlyatenko, N N & Kulikov, N A)
A	-	GB 2266354 A	(Jupitor Corporation)

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X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[V]:

F2Q

Worldwide search of patent documents classified in the following areas of the IPC[7]:

F01D & F16C

The following online and other databases have been used in the preparation of this search report:

Online: WPI, EPODOC & JAPIO