Neutral Citation Number: [2007] EWHC 1367 (Pat)

Case No: HC05C04082

IN THE HIGH COURT OF JUSTICE
CHANCERY DIVISION
PATENTS COURT

Royal Courts of Justice
Strand, London, WC2A 2LL

Date: 15 June 2007

Before :

THE HONOURABLE MR JUSTICE PUMFREY

- -

Between :

TRIUMPH ACTUATION SYSTEMS LLC
(formerly known as FRISBY AEROSPACE LLC) **Claimant**

- and -

(1) AEROQUIP-VICKERS LIMITED
(2) EATON LIMITED **Defendants**

- -
- -

Guy Burkill QC and **Thomas Hinchliffe** (instructed by **Ashurst**) for the **Claimant**
Michael Silverleaf QC and **Mark Vanhegan** (instructed by **HGF Law**) for the **Defendants**

Hearing dates: 28 February – 7 March 2007

- -

Approved Judgment

I direct that pursuant to CPR PD 39A para 6.1 no official shorthand note shall be taken of this Judgment and that copies of this version as handed down may be treated as authentic.

.....

THE HONOURABLE MR JUSTICE PUMFREY

Mr Justice Pumfrey :

Introduction

1. This is an action for infringement of EP (UK) 0280532, which now stands in the name of the Claimant, Triumph Actuation Systems LLC ("Triumph"). The patent was originally granted to Allied-Signal, Inc, but the original applicant was called Garrett Corporation, and during the proceedings the power transfer unit that is the subject of the patent tended to be referred to by the name "Garrett".

2. This power transfer apparatus is a piece of hydraulic equipment used in the A320 family of aircraft manufactured by Airbus Industrie. It is a device for maintaining pressure in either one of two hydraulic circuits by employing available power in the other. It consists of two hydraulic pump/motor units, one fixed- and one variable-displacement, connected mechanically by a common shaft, each pump/motor being hydraulically connected to one of the two circuits. The units are called pump/motors because certain hydraulic pumps may equally function as hydraulic motors, and so the two pump/motors can be arranged so that either is capable of acting as a motor driving the other, which then functions as a pump and operates to maintain the pressure in the hydraulic circuit to which it is connected. The patent is concerned with the control mechanisms for the back-to-back pump/motors.

The Issues in the Proceedings

3. The patentee does not defend the validity of the claims as granted. It applies to amend the patent by incorporating the features of claim 6 (though not the features of the claims to which claim 6 is dependent) into claim 1. This amendment is opposed by the defendants, Aeroquip-Vickers Limited and Eaton Limited ("Vickers"), essentially on the grounds that it lacks clarity and that it offends against s.76 of the Patents Act 1977 (and Article 123 EPC). The defendants also contend that these amendments, which are made very late in the life of the patent, should be refused in the exercise of the Court's discretion, but by agreement issues relating to discretion have been put off until the question of allowability and validity of the claim as proposed to be amended have been decided.

4. The validity of the claim as proposed to be amended is challenged on the basis primarily of a lecture given at the 30th Vickers Aerospace Fluid Power Conference. The lecture in question was concerned with the hydraulic system for the Airbus A320 aircraft, which (with its associated aircraft, the A319 and A321) is the only aircraft in which, so far as the evidence goes, the invention has been used. The lecture is said by the defendants to provide all that is necessary for the construction of a power transfer unit (henceforth "PTU") that falls within the amended claim. There was also reference to US 3,691,767 (Abex). This patent specification describes a PTU that was used on the DC10 aircraft.

5. The specification is concerned with a complex piece of hydraulic equipment. The addressee is a hydraulics engineer and the experts, Mr Lattimore for Vickers and Professor Watton for Triumph, were agreed that such a person would either possess a relevant engineering degree or its equivalent. He or she would also have practical experience. As a matter of common sense one would expect that in such a specialist application it is likely that the addressee would have experience in the aeronautical

hydraulics field, and I was satisfied by the end of the case that some knowledge of aeronautical hydraulics applications should appropriately be attributed to the addressee of this specification. There is, however, little doubt that the applicable general principles are common to all hydraulics engineers of the appropriate attainment.

6. In this connection, Mr Lattimore was a highly experienced hydraulics engineer, who had terminated his career as Chief Fleet Engineer for Concorde in 1993. He had started his experience of hydraulics in 1963 when he joined Vickers Armstrong (Aircraft) Limited as a development engineer and had worked on hydraulic actuation of landing gear for the TSR 2. He had worked also on the development of hydraulic flying controls for civil and military aircraft at Fairey Hydraulic Limited before, as it were, changing sides and working at BOAC as a development engineer for the Boeing 747 and subsequently for Concorde. His knowledge of the relevant area was extensive and his evidence was authoritative.

7. After 11 years in industry, Professor Watton had entered academia in 1971, where he has continuously been associated with research into fluid power, including the dynamics of servovalves and two-stage pressure relief valves, and subsequently wide-ranging research into really all aspects of the control and performance of hydraulic circuits. Necessarily, this work has been in collaboration with industry. He too was well qualified to give evidence on the issues that arise in this case, and I thought that his differences of opinion with Mr Lattimore might, at least in part, be attributable to a more academic approach.

8. Both Triumph's predecessor in title, Garrett, and Vickers were closely involved in the events leading up to the design of the PTU described in the patent in suit, and, since both parties regarded these events as important, it is convenient to deal with them here, before turning either to the patent or to the specific attacks made upon it. In 1984, Messerschmitt-Bolkow-Blohm ("MBB"), acting on behalf of Airbus Industrie, produced a specification for the PTU that was sent, it would seem, to Garrett, Vickers and others. This document, reference 2910 MIE 000100, is dated 31st March 1984 and entitled "Hydraulic Power Transfer Unit – Reversible". In part 2.2.1 of this document, which is entitled "Architecture of the equipment and overall design requirements", the equipment architecture is described as follows:

> "The power transfer unit consist of:
>
> - One fixed displacement hydraulic motor connected to the green system
>
> - One variable displacement motor connected to the yellow system
>
> - Displacements required for the "Yellow Motor":
>
> (a) Max. displacement
> Power transfer to green system (Motor operation)
> (b) Min. displacement
> Power transfer to yellow system (Pump operation)

(c) Neutral displacement
Power Transfer Unit inoperative (no rotation) at pressure differences between green – and yellow system lower than specified – displacement.

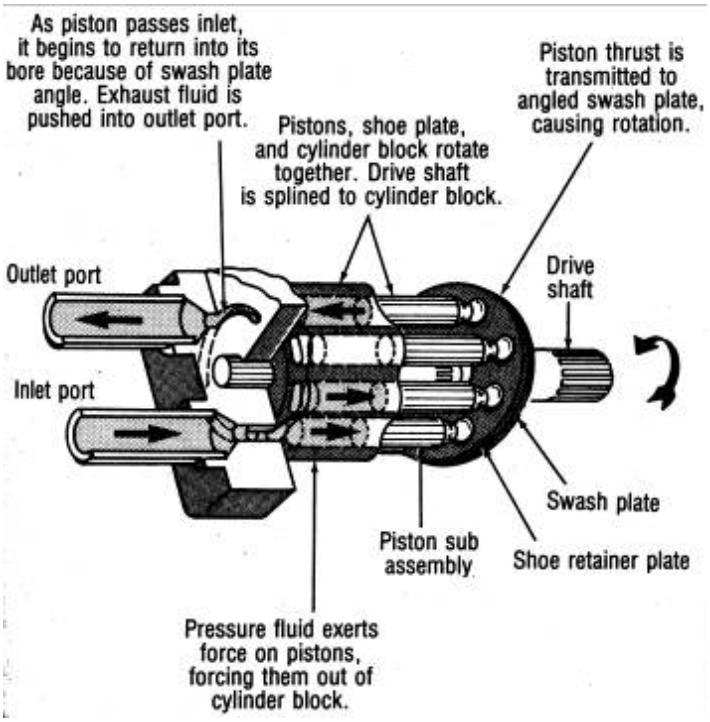
- The displacement change shall be done by a device integrated in the power transfer unit.
- The yoke position for neutral displacement shall be spring centered.
- The displacement control or/and switching logic shall be a part of the Power Transfer Unit or an additional item to be delivered by the supplier.
- The power transfer shall be ensured by a drive shaft between the two motors.
- Depending on the direction of power transfer each motor has to work either as pump or motor.
- Each motor shall have three hydr. Connections
  - Pressure
  - Return/Suction
  - Case Drain
- One seal drain connection is required for the external leakages of both motors."

This short passage in a lengthy document contains references to pretty well all the items of common general knowledge with which the action is concerned. Earlier paragraphs (2.1.1 and 2.1.2) of the specification describe the role of the equipment, which may be summarised as follows.

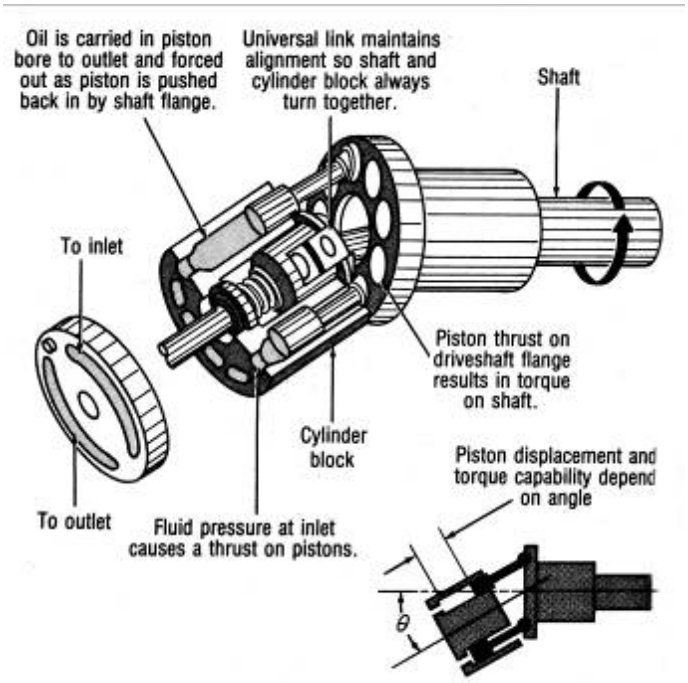
9. For this purpose it is only necessary to know that the PTU is to operate between two of the A320's three hydraulic circuits. The three circuits are labelled blue, green and yellow, and the unit operates between the yellow and the green. The PTU is to enable the green system to be supplemented by the yellow system and vice versa when required. In flight, the purpose of the unit is to ensure two essential functions: supply to the green system, mainly for gear retraction in the event of engine 1 failure during take off; and supply to the yellow system, mainly for the elevator servocontrol connected to the yellow system in the event of a double failure (blue system failure followed by failure of engine 2). On the ground, the purpose of the unit is to enable the green sub-system to be run by power transfer to the yellow, which is pressurised by an electric motor.

10. The other essential feature of the device which it is necessary to refer to at this stage is that the only connection between the green and yellow system is the mechanical connection effected by the shaft joining the two motor/pump units.

11. The paragraph of the specification that I have set out above accordingly specifies one fixed displacement hydraulic motor connected to the green system and one variable displacement motor connected to the yellow system. The terms "fixed displacement" and "variable displacement" are terms of art, and refer to what are called swashplate units. In a swashplate motor, pistons running in two or more cylinders positioned around the motor shaft bear upon a so-called swashplate, which is a circular plate fixed at an angle relative to the shaft. Pressure in a cylinder whose piston is towards the top of its travel (and descending) exerts force upon the swashplate tending to rotate the cylinder, and the rotating cylinder accordingly causes each of the pistons to reciprocate. Such a device is inherently reversible, and can be used either as a motor or as a pump for maintaining pressure and oil-flow in a hydraulic system. Such motors are standard components. In order to illustrate them, I include a figure obtained by Mr Lattimore from a 1984 handbook of hydraulic equipment.



12. Instead of using an angled swashplate and an inline drive shaft, it is possible to achieve the same reciprocating movement by the use of a so-called bent-axis motor in which the piston assembly as a whole rotates. Again, this is shown in the accompanying figure.



13. A variable displacement motor is one in which the stroke of the pistons can be adjusted. Conceptually, this is most easy to visualise in the straight-axis type of motor. The swashplate is mounted in a yoke and the angle of the yoke to the axis of the cylinders can be altered. The method of alteration may be as simple as a lever placed on the outside of the pump, or it may be moved by hydraulic or electrical means. Again, the cylinder block rotates in consequence of the reaction between the ends of the pistons and the swashplate.

14. In the MBB document, little is said about the control system, and many of the essential criteria for the control system are stated to be "TBD" or to be discussed. However, it may be observed immediately that the "yellow motor" will act as a motor when its displacement is at a maximum and will act as a pump when its displacement is at a minimum. In other words, it must be capable both of driving and of being driven by the green motor. The specification states that this result is to be achieved by changing the effective displacement of the motor, and this means, as I understand it, that a variable displacement bent axis or inline piston motor will immediately be contemplated by the skilled man. It will also be obvious that the necessary displacement control will operate the yoke adjustment mechanism (i.e. the swashplate angle control mechanism) in the sense required. The whole of the case is about the adjustment mechanisms.

15. Apart from the basic motor arrangements to which I have referred, one other matter can conveniently be referred to at this point. This is the question of valves that are used for hydraulic controlled circuits. Commonly, hydraulic valves are sliding action, and the commonest variety of sliding action valve is what is called a spool valve. The spool valve consists of a cylindrical bore with annular ports. The spool is a rod-like member which slides in the bore, machined onto which are annular lands. The lands open and close the annular ports, and the reduced-diameter regions between them establish transfer paths between the ports so opened. The Fluid Power Handbook (1986-1987 edition) which was established to be representative of the common

general knowledge contains many examples of cross-sectional diagrams and photographs of spool valves.

16. With that introduction, it is possible to turn to the patent in suit, the context for which is provided by the common general knowledge to which I have referred and the stimulus for which was the A320 specification.

The Patent in Suit

17. The Patent in Suit was granted on an application filed 24th February 1988 to which I shall have to return. The field of applicability of the invention is described at column 1 line 1, as follows:

> "The field of the present invention is reversible hydraulic motor-pump units. More particularly, the present invention relates to power transfer units in which two reversible hydraulic motor-pump units are coupled for torque transfer between them. Each one of the motor-pump units is associated with a separate hydraulic system having its own main high-pressure pump and fluid reservoir. By means of the power transfer unit, hydraulic power may be borrowed from one system for conversion into mechanical power by one of the motor-pump units, and then converted by the other motor-pump unit into hydraulic power which is supplied to the other of the two hydraulic systems."

18. After having acknowledged that the use of power transfer units in aircraft is conventional, the specification continues at column 1 line 41 to identify shortcomings of such units. These disadvantages are:

a) a tendency to operate too frequently;

b) consequent increased wear and shortened service life;

c) the possibility of failure of one portion of the unit resulting in failure of both the systems due to fluid leakage between the two systems;

d) the use of relatively complex electro-hydraulic control systems.

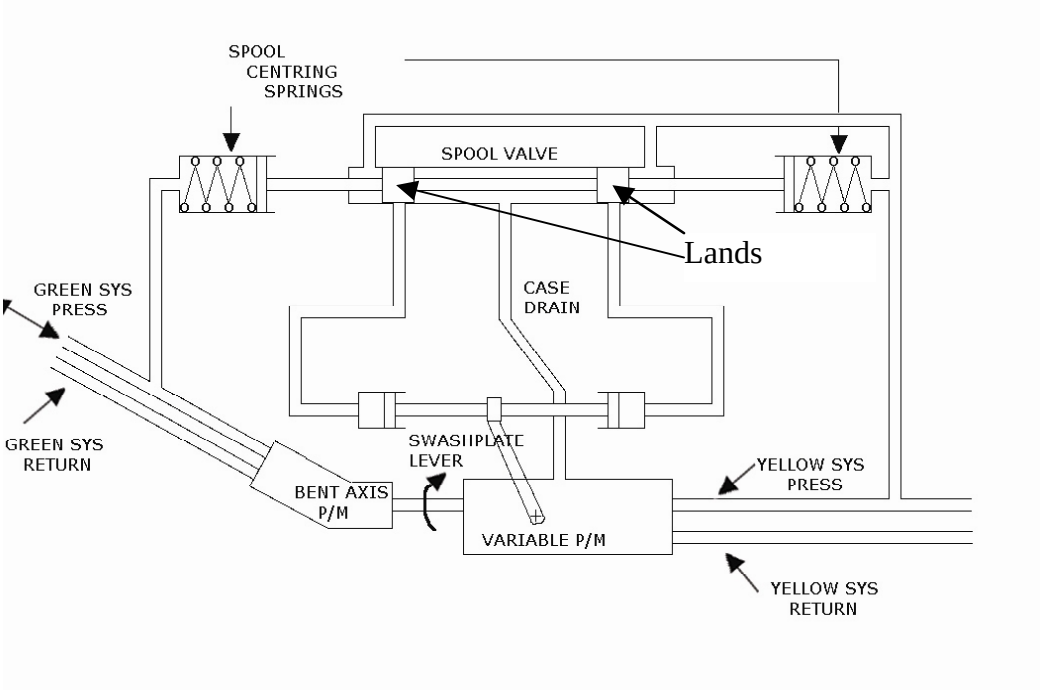
The object of the invention is said to be (column 2 line 8ff.) to overcome these particular problems. So far as the problem of frequent operation is concerned, it is said that it is an additional object of the invention to provide a PTU which, once operating, will maintain a pressure differential between the coupled hydraulic systems lower than the differential necessary to begin operation of the unit. This means that at the end of a cycle the system is intended to overrun before closing down. The turn-off pressure differential is lower than the turn-on pressure differential. Finally, it is to be noted that it is an object of the invention to provide a system the control in which is entirely hydraulic.

19. After a comparatively brief introduction the specification then sets out the claim. The claims of this document are remarkably long, and the divisions between them are not

quite agreed. The amendments proposed by the claimant are far-reaching, and it is convenient, before turning to the claims, to consider the preferred embodiment.

20. Figure 1 of the patent shows in outline where the PTU of the invention, labelled 32, fits in between two hydraulic systems. Figure 2 shows the heart of the invention, although the spool valve, generally indicated at 124, is shown enlarged in Figure 3. In Figure 2 can be seen the two back-to-back motors 50 and 68, motor 68 being a fixed-displacement bent-axis type and 50 being an axial variable-displacement type. The two motors are separated by back-to-back oil seals 90 and 92, and the swashplate, which is generally denoted by 60, is moved by the arm 94, the movement of which is controlled by two opposed hydraulic cylinders at 212 and 214. These small cylinders are each surrounded by springs that engage collars 120 and 122, which serve to centre the operating arm 102, when no pressure is applied to the cylinders 212 and 214 and also to provide a spring resistance against movement when there is a net pressure differential between the two cylinders. Essentially, the resistance provided will be proportional to the displacement of the actuating rod 102.

21. The only pressure applied to the two cylinders 212 and 214 is applied on the two lines 206 and 210. The pressure, whether applied on line 206 or on line 210, is derived from one only of the two hydraulic systems between which the PTU is positioned, and the function of the spool valve is to apply pressure either on line 206 or on line 210, depending on whether the pressure on that side is greater than or less than the pressure in the other hydraulic circuit. The idea of the spool valve is that it in effect slides towards the side that has the lower pressure, the lands (raised portions of the spool) thereby opening the ports (source of hydraulic pressure) to that one of the pair of cylinders 212 and 214 as will move the lever in the appropriate direction to adjust the displacement of the adjustable-displacement motor so that it operates either as a motor or as a pump, as appropriate. The whole can be seen in a simplified diagram which was produced by Mr Lattimore and which I reproduce below, with a small addition to indicate the lands on the spool.



The Claims

22. Triumph do not defend the claims as granted, but maintain that the new claim sought to be introduced by amendment is both valid and infringed. In structure, new claim 1 is straightforward. It consists of the features of old claim 1 and the features listed in old claim 6. It does not consist merely of writing the features of old claim 6 into claim 1, because the former was dependent upon claim 5, itself dependent upon claims 3 and 4 and so upon claim 2 also, and none of those features are sought to be introduced into the new claim. I shall deal with the consequences of this below. The claim is as follows, broken up by features. The experts were largely agreed on the manner in which the claim should be decomposed, but I set out their respective letters (Professor Watton) and numbering (Mr Lattimore):

> "(a) Power transfer apparatus which comprises
>
> (b)(1) a first fluid pump-motor unit having associated high and low pressure fluid ports for connection to a first pressure fluid source and a first rotary shaft the first unit being operable to convert energy between pressurised fluid flow and mechanical rotation of the first shaft;
>
> (c) a second fixed displacement fluid pump-motor unit also having associated high and low pressure fluid ports for connection to a second pressure fluid source and a second rotary shaft, the second unit being operable to convert energy between pressurised fluid flow and mechanical rotation of the second shaft,
>
> (d)(2) the first and second shafts being mechanically interconnected for common rotation to transmit power between the first and second units without mixture of their respective fluids;
>
> (e)(3) and control means responsive to the pressure of the high pressure ports of both the first and second units and operable to maintain the pressure differential therebetween below a preselected level whenever the first and second shafts are rotating;
>
> (f)(4) characterised in that the first unit is a variable displacement unit of the axial piston swashplate type with a variable swashplate member and
>
> (g)(5) in operation, the control means adjusts the position of the swashplate member
>
> (h)(6) further characterised in that the control means further includes valve means communicating ~~one~~

~~of the~~ a variable-volume chamber with the higher pressure fluid of the first pressure fluid source while simultaneously communicating ~~the other~~ another variable-volume chamber with the lower pressure fluid of the first pressure fluid source, in response to movement of the valve means in a selected one of two directions; the said variable volume chambers each comprising a plunger operable to adjust the position of the swashplate member;

(i)(7) pressure responsive means operatively associated with the valve means for removing the latter in each of the two direction,

(j) the pressure responsive means having a first pressure responsive face and an oppositely disposed second pressure responsive face sealingly separated from one another;

(k)(8) means communicating the first pressure responsive face with the comparatively high pressure fluid of the first pressure fluid source to effect movement of the pressure responsive means and the valve means in one of the two directions to communicate the other variable volume chamber with the comparatively high pressure fluid;

(l)(9) means communicating the second pressure responsive face with the relatively higher pressure fluid of the second pressure fluid source to effect movement of the pressure responsive means and the valve means in the other direction to communicate the one variable volume chamber with the comparatively higher pressure fluid;

(m)(10) and resilient means yieldably biasing the pressure responsive means and the valve means to a centred position in which neither of the two variable volume chambers communicates with the comparatively higher pressure fluid."

23. It will be observed that the claim contains a number of functional relationships. The first is feature (e): the control means (32), which includes both the swashplate operating cylinders and the spool valve, is "responsive to the pressure of the high pressure ports of both the first and second units and operable to maintain the pressure differential therebetween below a pre-selected level whenever the first and second shafts are rotating", the units being the rotary units and the high pressure ports being at the pressure of the respective circuits. Looking, for a moment, at the preferred

embodiment, the scheme of things is, as I have indicated, that the spool valve will open to supply the appropriate side of the two motor/pump units with fluid under pressure from the yellow circuit and, provided that pressure is high enough to overcome the so-called "break-out" pressure, the unit selected as the motor will begin to turn. The other unit will start to act as a pump, and will continue to do so while the net torque produced by the motor is sufficient to overcome the running friction of the two units. If there were no control, this would happen anyway unless the additional load on the pump/side circuit required the PTU to run continuously.

24. Accordingly, feature (e) – which must be dealing with the steady state operation of the device – requires the pump to respond to the pressure differential. If the motor is the variable-displacement unit, this feature means that the swashplate lever must be moved so as to increase the torque of the motor sufficiently to drive up the pressure at the outlet port of the pump. On the other hand, if the variable-displacement device is operating as the pump, then the position of the swashplate must be adjusted so as to increase the pressure at the outlet accordingly.

25. Feature (h) is introduced by amendment. It is directed at the so-called "variable volume chambers", which in the claims prior to amendment were introduced in claim 5. Lacking this antecedent, it was necessary for the claimant to propose a further amendment explaining what the two variable-volume chambers were, and this is the purpose of the words struck out and underlined in feature (h) above. This further amendment was proposed at a late stage, in response to the defendants' objections to the form of claim as proposed. Feature (h) is concerned accordingly with the operation of the swashplate lever. It calls for a swashplate lever operating mechanism which depends upon the pressure available on one side only of the PTU. The high pressure side is connected either to one or the other of the variable-volume chambers. The other variable-volume chamber is connected to the low pressure side of that circuit. As the claim stands, there is no requirement for movement proportional to pressure: accordingly, it covers what has been called a bang-bang mechanism in which the swashplate is not biased towards its central position.

26. Finally, features (i) to (m) deal with the movement of the spool valve and the hydraulic connections effected by those movements. In summary, the spool valve is biased by springs (feature (m)) to a central position, from which it is moved by a pressure differential between the "yellow" and "green" systems. The movement, being biased by springs, will be proportional to the pressure differential and, depending upon the direction of the difference, will cause the swashplate lever to be moved in such a direction that the variable-displacement unit acts either as a pump or as a motor accordingly.

27. Some light is thrown on the breadth of feature (e) of the claim from a consideration of claim 2, which is as follows:

> "Apparatus of claim 1 characterised in that
>
> when the power transfer unit is operating to transfer power from the first fluid pump-motor unit to the second fluid pump-motor unit, the swashplate member is positioned in a range extending from its maximum displacement position to its rest position

> and if the power transfer unit is operating to transfer power from the second fluid pump-motor unit to the first fluid pump-motor unit, then the position of the swashplate member is modulated in a range extending from its minimum effective displacement position to its rest position."

28. While the word "modulated" gave rise to a considerable dispute at trial, it seems to me that the passage in the specification describing the operation of the motor (column 12 line 47 to column 13 line 32) strongly suggests that some form of continuously variable operation of the swashplate lever is contemplated by this claim. So far as the described embodiment is concerned, the evidence is that the two springs 108 and 110 must be present. Without them, only "bang-bang" operation is possible. Given that the effective operating force on the swashplate lever is provided either by the variable-volume chamber 212 or the variable-volume chamber 214 when supplied by hydraulic fluid from the "yellow" side of the circuit, it necessarily follows that if this whole arrangement is to provide some sort of variable displacement which depends upon the pressure differential between the two circuits, then the spool valve must operate so as to modulate the pressure applied to the one side or the other, and so modulate the force applied against the resistance of either the spring 108 or the spring 110. The description (column 10 line 47 to column 11 line 31) is far from clear on this important aspect of operation of the device. Professor Watton was of the view that this reduction in pressure did, indeed, take place, so that the displacement of the swashplate lever, and so the displacement of the motor/pump unit, were proportional to the pressure differential between the two circuits. In paragraph 4.11 of his first report, he makes this explicit. I think that Mr Lattimore accepts this, provided that there is some mechanism for centring the swashplate actuators in their "rest position". He observes, as is the case, that the essential scheme is that the spool valve operates on the pressure differential between the two circuits, perhaps some hundreds of psi, while the swashplate actuators operate at the pressure in one circuit, nominally 3,000 psi. As I finally understand the evidence, it is possible to modulate the pressure applied in this way by means of very small movements of the spool valve, and I shall assume that this is what happens. However, it is plain that the new claim 1 covers systems in which no such modulation is possible because the only restraints on the movement of the swashplate actuator are the stops at each end of its travel and, further, that so far as the description is concerned, the modulation of the position of the actuating lever is not described at all except by the force of one or other of the actuator unit springs opposing the applied pressure, itself varied by the operation of the spool valve.

29. I shall return to the question of the operation of the preferred embodiment, the scope of the claim and the ability of the unit with "bang-bang" operation to maintain the pressure differential between the coupled hydraulic systems lower than the predetermined pressure differential necessary to begin operation of the PTU, when I consider the sufficiency of the description.

Infringement

30. The description of the alleged infringement is very clear. The main point of distinction between the apparatus described in the patent and the alleged infringement is a straightforward mechanical feedback applied from the yoke position in the variable displacement unit to the plunger means operating one end of the spool valve.

The effect of the feedback mechanism is to move the cup in which the equivalent of the spring 138, whose function is to centre the spool valve. The effect of the operation of this positional feedback is complicated, but its effect is to reduce the movement of the spool when the pressure in the yellow system is greater than that in the green system. This mode of operation is symmetric, and always operates so as to somewhat reduce the movement of the spool responding to a given pressure differential from that which it would otherwise have been, in response to the degree to which the yoke-operating cylinders have moved the yoke in the variable displacement unit.

31. It is accepted that if the claim is construed so that there is no requirement, express or implied, that feature (h) requires the presence of springs associated with the variable-volume chambers to centre the swashplate, then there is infringement, subject to the point below.

32. It seems to me that while the defendants' device contains the essential components to enable the yoke to be positioned in a manner appropriate for the demand placed on the device, there is little doubt that it otherwise possesses all the features of the claim, subject only to one question. This arises in relation to features (i) and (j): the "pressure responsive means". This is, in fact, a narrow point. One of the avowed requirements of this device is to keep the two hydraulic circuits between which it operates isolated from each other. While it is necessary to have regard to the pressure in both systems in order to determine whether the device is to operate and, if so, in which direction, that is the extent of the requirement. The other requirements can be met by employing motor/pump units which, while driven by or driving their respective circuit, are bridged only by a rotating shaft and by operating the system for controlling the swashplate position by means of what is in effect a jack operated by the pressure of one circuit only. It is, however, necessary to control the valve operating this jack by reference to the pressure differential between the two circuits, and this is achieved in the preferred embodiment by applying the pressure in each circuit to the opposite ends of the spool valve. The circuit which is not employed to operate the variable displacement mechanism is isolated from the remainder of the spool valve by a long operating rod which is, in the preferred embodiment, provided with a number of seals. These are shown clearly in figure 3. In the result, hydraulic fluid applied at input 146 operates on the spool valve effectively at the end of the plunger 134, and the hydraulic fluid from that system gets no closer to the spool valve than that. The description in the claim is manifestly clumsy, but it covers the possibility that the two pressure responsive means, with their first and second pressure responsive faces, are not co-linear with the valve itself. In the alleged infringement, a long plunger is used to transmit the force exerted by the pressure in the "green" circuit to the spool valve, the pressure of the green circuit being applied to what is in effect a plunger hydraulically connected to the green circuit. The portion of the plunger to which hydraulic pressure is applied is separated from the yellow circuit by considerable distance, and labyrinth seals. I see no real point of differentiation here and I conclude that the claim, as proposed to be amended, is infringed.

33. The position of claim 2 is much more complex. Because of the manner in which the feedback mechanism that I have described above operates, there is no predetermined position which is taken up by the yoke of the variable-displacement unit when the pressure in the two circuits are sufficiently close that the unit stops running. That this

is so appears from paragraph 47 of the description of the alleged infringement. Mr Burkill QC on behalf of the claimant relies upon a short passage in the cross-examination of Mr Lattimore at page 617-8 of the transcript, to suggest that a number of rest positions is contemplated by the claim, but I do not so read Mr Lattimore's answers. Indeed, the questions do not suggest that a single "rest position" is not what the specification describes. There is no range of rest positions. Professor Watton accepted (transcript page 494) that there were a range of positions which the alleged infringement would take up, but did not, as I understand it, consider that the patent describes anything of the sort. In my view, the words "rest position" should be given the straightforward meaning that they have in context, which is the position determined by the force of the springs in the actuator when no pressure is applied. For this reason, there is no infringement of claim 2. This is not a narrow basis for this determination, but a recognition that the rather different ways in which the positive positional feedback of the alleged infringement operates in contrast to the actuator described in the patent on the other, where, as I have endeavoured to explain, the displacement depends upon the pressure applied to the actuator by means of the spool valve.

Allowability of the Amendments

34. The allowability of amendments, whether to applications or to patents, is regulated by section 76 of the Patents Act 1977. The section regulates amendments made both before and after grant, and of course the current amendment is one made after grant. This case raises a peculiarity, and it is necessary to set out the whole of section 76, remembering that all the sections mentioned in it, with the exception of sections 27, 73 and 75, are sections concerned with proceedings before the grant of the patent.

> "76. – (1) An application for a patent which –
>
> (a) is made in respect of matter disclosed in an earlier application, or in the specification of a patent which has been granted, and
>
> (b) discloses additional matter, that is, matter extending beyond that disclosed in the earlier application, as filed, or the application for the patent, as filed,
>
> may be filed under section 8(3), 12 or 37(4) above, or as mentioned in section 15(4) above, but shall not be allowed to proceed unless it is amended so as to exclude the additional matter.
>
> (2) No amendment of an application for a patent shall be allowed under section 17(3), 18(3) or 19(1) if it results in the application disclosing matter extending beyond that disclosed in the application as filed.
>
> (3) No amendment of the specification of a patent shall be allowed under section 27(1), 73 or 75 if it –

> (a) results in the specification disclosing additional matter, or
>
> (b) extends the protection conferred by the patent."

35. I am concerned with the prohibition of section 76(3)(a). What is said is that there was no disclosure in the specification prior to amendment of the combination now sought to be claimed, which is accordingly additional matter in the sense that it is a new inventive concept neither disclosed nor unambiguously derivable from the specification prior to amendment. Mr Burkill submits that that is the wrong question and that the correct question is whether the effect of the amendment is to result in the specification disclosing additional matter over and above that disclosed in the application as filed. A great deal of material in the application was deleted during the course of prosecution, and Mr Burkill says that on a proper analysis the combination now sought to be claimed is there disclosed. So he says that sub-section (3)(a) is to be construed as meaning that the additional matter referred to is matter additional to that disclosed in the application as filed, rather than in the specification of the patent prior to amendment. Whether or not Mr Burkill is right as to the effect of the disclosure of the application as filed – and I think he is wrong – this is a point that I must resolve.

36. As is well known, certain provisions of the 1977 Act are framed so as to have the same effect as the corresponding provisions of the European Patent Convention. Section 76 is not one of those sections, although it is closely related to the provisions of articles 76(1) and 123 EPC. Oddly, an amendment improperly allowed under s.76 is a ground for revocation under s.72(1)(d) or (e) and these are provisions which are mentioned in s.130(7). I suspect that the reason that s.130(7) does not apply to s.76 is that s.76 deals not only with divisional applications (the principal concern of sub-section (1)) and with amendment during the course of prosecution, when the claims may be widened in scope (sub-section (2) and see *Southco v. Dzus* [1990] RPC 587, [1992] RPC 299), but also with amendments after grant outside the context of revocation proceedings, which is one of the subjects of sub-section (3) but which does not, at present, have any counterpart in the EPC. I am satisfied, however, that the principles elaborated in the EPO for testing whether the application discloses "matter extending beyond that disclosed in the application as filed" are directly applicable.

37. When one comes to sub-section (3), it needs to be remembered that two things may have happened to the original application in the course of prosecution in the Patent Office. First of all, the claims may have been substantially amended in response to the examiner's objections, whether on the grounds of lack of clarity or lack of support (see s.14 of the 1977 Act) or because in the examiner's view the claims as applied for cover subject-matter that is either old or obvious. The second thing which may have happened – and has happened in the present case – is that descriptive passages in the specification may have been deleted, perhaps because they no longer relate to any claim. In such a case, it will be possible for the scope of the amendments to the body of the specification to be ascertained by comparison of the specification of the patent as granted with the specification of the application as published under s.16.

38. The general policy underlying the prohibition on amending a specification so as to include added matter (or permitting a divisional application, which is entitled to priority from the priority date of the parent application, which includes any such matter) is clear enough. An applicant is only entitled to priority in respect of subject-

matter of which he was aware and which he recorded in the application from which he claims priority. He cannot retain priority while adding to that material, because to do so would permit him to add subject-matter potentially inventive after the date which he claims as the date on which he filed for protection of that invention. So, the prohibition on the addition of matter during the application phase of a patent is designed to protect the mechanism for the claiming of priority, upon which the whole of the international patent system depends.

39. What, then, if the patentee seeks to rely upon the disclosure of the application as filed to support an amendment introducing features which had been deliberately removed from the specification in the course of prosecution? As a matter of interpretation, there is the obvious contrast between sub-sections 76(2) and (3)(a), the former expressly indicating the document with which the comparison has to be made and the latter indicating as a matter of language that the comparison is to be made with the specification of the patent prior to the amendment. The matter does not stop there, however. For the first time in UK patent law, the 1977 Act made provision for the revocation of patents and claims which broadly had been amended in a manner not permitted by s.76. Section 72(1)(d) provides that the patent may be revoked on the ground that "the matter disclosed in the specification of the patent extends beyond that disclosed in the application for the patent, as filed, or, if the patent was granted on a new application filed under section 8(3), 12, or 37(4) above or as mentioned in section 15(4) above, in the earlier application, as filed". It appears to follow that once matter is present in the application as filed, its reintroduction by amendment after grant, after its deletion during the course of prosecution, is not objectionable.

40. This fact is not, of itself, conclusive, if only because not every failure to comply with the mandatory requirements of a patent specification gives rise to a corresponding invalidity. For example, failure to comply with the requirements of sub-section 14(5) that the claim should be clear and concise, supported by the description, and relate to one invention, does not result in the invalidity of the claim in question. Nevertheless, it certainly supports the view expressed in *Terrell on the Law of Patents* (16th ed.) paragraph 9-08, that the comparison in both sub-sections (2) and (3)(a) of s.76 is to be made with the application as filed.

41. Given that the provisions of art.123 EPC apply during opposition proceedings which take place after grant and in respect of a patent the specification of which may have been amended during prosecution, it seems to me that it would be an unjustifiable departure from the overall scheme of European patent law if s.76(3)(a) required the necessary comparison to be made with the specification prior to amendment rather than with the application as filed. In the result, therefore, I consider that in the present case the necessary comparison must be performed with the application as filed.

Is the combination of Amended Claim 1 disclosed in the Application?

42. The application for the patent as filed contains, as I have indicated, substantial material excised from the patent as granted. Mr Burkill QC bases his contentions upon a passage at column 8 line 11, as follows:

> "According to another aspect of the invention, there is provided in a power transfer unit coupling two otherwise separate hydraulic systems for bidirectional transfer of hydraulic power

> therebetween without transfer of fluid therebetween, and having a first variable displacement motor-pump unit having a rest displacement coupled in torque transmitting relationship with a second fixed displacement motor-pump unit, each of the motor-pump units being sealingly separated and fluidly communicating with a respective one of the two hydraulic system[s], the power transfer unit having a determined static breakaway torque necessary for starting operation of the coupled motor-pump units, which breakaway torque is provided by the difference between the respective driving and resisting torques of the coupled motor-pump units, the method of operating the power transfer unit comprising: with the coupled motor-pump units static, lowering, with respect to the rest displacement, the effective displacement and resisting torque of the first motor-pump unit in response to relatively lowered pressure of the hydraulic system coupled thereto and anticipation of the operation of the first motor-pump unit as a pump driven by the second motor-pump unit, and increasing with respect to the rest displacement the effective displacement and driving torque of the first motor-pump unit in response to relatively lowered pressure of the hydraulic system coupled to the second motor-pump unit and anticipation of operation of the second motor-pump unit as a pump driven by the first motor-pump unit.
>
> Such a method may also include setting a determined pressure differential between the hydraulic systems necessary for static breakaway to begin operation of the coupled motor-pump units by variation of the effective displacement of the first motor-pump unit selectively below and above the rest displacement. The method may also include, during operation, of the coupled motor-pump units, controlling the effective displacement of the first motor-pump unit during its operation as a pump in a range bounded by the rest displacement and a comparatively lowered displacement, and during operation of the first motor-pump as a motor, controlling its displacement in a range bounded by the rest displacement and a relatively increased displacement."

43. Prior to amendment, claim 1 generally calls for back-to-back motor-pump units and a control means responsive to the pressure differential between the associated circuits, the characterising features of the claim establishing the relationship between the control means and one of the motor-pump units for maintaining the pressure differential below the pre-selected level:

> "Characterised in that the first unit (50) is a variable displacement unit of the axial piston swashplate type with a variable swashplate member (60) and in operation, the control means (32) adjusts the position of the swashplate member."

44. The features of claim 6 relate not only to the control means (32) but also to "variable volume chambers" which are, in fact, features of the jack used to "adjust the position

of the swashplate member". So far as this description in the application as filed is concerned, the features of claim 6 are relevant only to the form of jack described. They are not said to be relevant to any other form of adjustment, and, in particular, not a form of adjustment that employs some form of direct positional feedback to the spool valve, rather than the springs ("resilient means") 108 and 110. In other words, the features of claim 6 are described in the specification to the supply of a two-ram spring-biased jack.

45. Against this, it is submitted that, in fact, the features of claim 6 just relate to the control valve itself, and what is done with the output lines from the control valve need not be specified for the purposes of defining the invention with this degree of generality. Mr Burkill QC bases himself upon paragraphs 5.6 to 5.8 of Professor Watton's expert report, where he says that the disclosure of the patent (and of the application) is of a PTU comprised of three separate components which, Mr Burkill says, are the following:

    a) a pair of pump-motors connected together;

    b) a spool valve for detecting a pressure differential and directing fluid flow from one system only to move the position of a swashplate; and

    c) an actuation device for moving the swashplate in response to the fluid from the spool valve.

46. In fact, Professor Watton's second feature was:

> "a device (the spool valve) for detecting a pressure differential in each fluid system and in response to that pressure differential routing high and low pressure fluid from one of those systems to control the movement of the swashplate in a proportional manner".

47. It is the requirement that the swashplate be moved "in a proportional manner" which inevitably calls for some means of ensuring that the movement of the swashplate is proportional to pressure differential. I have endeavoured to describe above how, in the preferred embodiment of the patent in suit, this is achieved by the use of the two springs 108 and 110, together with a spool valve designed to provide a fluid pressure to the variable-volume chambers 212 and 214 that is proportional to the pressure differential detected by the spool valve. Some sort of interrelationship between the pressure differential detected by the spool valve and the movement of the swashplate-actuating lever must occur, because without some such arrangement, proportional operation is not possible. It seems to me that Mr Burkill's summary of Professor Watton's evidence in this respect does it less than justice, for the simple reason that if operation proportional to pressure is indeed a feature of the movement of the swashplate, then the features of the device described that are found in existing claim 6 are not independent, in fact, of the features found at least in original claims 2 and 3. In my judgment, the combination of these features at least is necessary before the PTU as a whole could function in the manner described in Professor Watton's paragraph (b), and I conclude that this amendment claims a new combination not hitherto described either in the application as filed or in the text of the patent as granted.

48. While that is sufficient to deal with this point, I should refer to one submission made by Mr Burkill QC on the basis of the passage that I have quoted above. Fastening on the words "rest displacement", he says that the first paragraph describes "bang bang" operation of the device, the second paragraph describing the displacement of the swashplate proportionally to the detected pressure difference. Unfortunately, I do not believe that this passage was relied upon by any of the witnesses, but the terms of the second paragraph do certainly appear to suggest that a method of operation of the device may include controlling the effective displacement of the variable-displacement unit. However, no indication is given of why such operation should take place, and in dependence upon what. At least as a matter of inference, one might suspect that the earlier paragraph is intended to cover bang-bang operation: but it does not seem to be concerned at all with a system involving spool-valve control. This is the natural consequence of a method, rather than apparatus, claim. The claim with which I am concerned is an apparatus claim, and, so far as the application as filed is concerned, no corresponding suggestion appears. Indeed, the features of claim 6 are described (column 3 line 24 of the application) as a preferable feature of the control means already described "further" to the features already set out.

49. I do not suggest that this is a question free from difficulty, but it seems to me that there is no distinct description of the combination of the proposed new claim 1 in the application as filed. Nor is there a teaching that the combination of claim 6 is "free standing" in the sense that it is applicable to anything other than the control means and the responsive means already described. So I reject Mr Burkill QC's submission on this point.

50. Finally, Mr Burkill QC refers to the objects of the invention. He suggests that proposed new claim 1 in fact satisfies those objects. This may well be true, but is irrelevant. The question with which I am concerned relates only to the question of what is disclosed in the application as filed. It is not whether the skilled man could, on examination, devise new things which satisfy the various objects of the invention. So I refuse the application to amend. The result is that the patent must be revoked, the patentee not seeking to defend existing claim 1 or the dependent claims.

Obviousness

51. I should discuss the question of obviousness of proposed amended claim 1, in case I am wrong about its allowability. As developed in cross-examination, the objection was based upon a single publication, the lecture at the Vickers Aerospace Fluid Power Conference, with the common general knowledge in the art. The common general knowledge was extensively explored by using the comparatively simple hydraulic structures described in the "Fluid Power Handbook", which was employed to demonstrate the sort of design decisions that a person skilled in the art would expect to take in the ordinary course of design work. The position is confused because MBB's technical requirements for the PTU for the A320 aircraft was discussed both with the original patentees, Garrett, and with Vickers. Mr Silverleaf QC on behalf of Vickers was inclined to suggest that each of the features of the PTU of the patent – the back-to-back motor-pumps, the spool valve and the actuator mechanism for the variable-displacement pump-motor – were each "doing exactly what you would expect irrespective of their surroundings". Mr Silverleaf accordingly submits that there is no synergy or additional effect in putting them together.

52. I think it is always important in cases concerned with mechanical inventions to ensure that illegitimate short-cuts are not taken to the question of inventive step. It goes without saying that in any new mechanical device each of the individual mechanical components is doing no more and no less than what it would always do. That says nothing about inventive step, or even about the relevant inventive concept. One normally approaches the question of inventiveness through the approach described by Oliver LJ in *Windsurfing International v. Tabur Marine* [1985] RPC 59, the four steps of the analysis being:

    i) to identify the inventive concept and the patent;

    ii) to assume the mantle of the skilled but unimaginative addressee, who must have imputed to him the common general knowledge of the art in question;

    iii) to identify what, if any, differences exist between the matter cited as part of the state of the art and the alleged invention; and finally

    iv) to decide whether, viewed without any knowledge of the alleged invention, those differences constitute steps which would have been obvious to the skilled man, or whether they require any degree of invention.

53. In the mechanical field, improvements brought about by inventive activity may well be modest. One can take from this case the example of the PTU already in existence that was discussed by the witnesses. The DC10 aircraft had a back-to-back or bidirectional PTU. This device was well known to Mr Lattimore and had been flying since August 1970, some 17 years before the priority date. Mr Lattimore gave evidence that in the aircraft hydraulic field the bulk of PTUs in use before the priority date were back-to-back pump-motors of equal displacement. Connected to a hydraulic circuit, the unit will remain stalled until the pressure on one side falls below a threshold value, when the high pressure side will begin to act as a pump. The device will continue to run until the pressures are sufficiently equalised for it to stall. Both units are of fixed displacement, and require no control. The DC10 unit did involve control of a variable-displacement unit back-to-back with a fixed displacement unit. The reason for using a controlled variable-displacement unit is that a fixed bidirectional PTU has too high a break-out pressure differential and stalls at too high a pressure differential between the units, as Professor Watton recognised. It seems that Professor Watton and Mr Lattimore agreed that the DC10 unit was by the priority date a well-known example of a bidirectional device made up of a fixed-displacement and a variable-displacement unit. I think Professor Watton, who was not concerned with aircraft units at the time, was perhaps drawing an inference from one of his own exhibits, an SAE Aerospace Recommended Practice, ARP1280, issued March 1976. This describes recommended practice in relation to equal-displacement bidirectional units and unidirectional units, but in paragraph 8.1 observes that there are several instances where variable units have been used in a PTU application. Mr Lattimore was quite clear that the skilled designer as at the priority date would be aware of this unit, although, as he freely admitted, it was not a satisfactory piece of equipment.

54. At this point, it is necessary to make a few observations about the design skills of the skilled person. The addressee undoubtedly has an engineering degree, or an equivalent qualification, and some practical experience, the lowest figure mentioned

being three years. Such a person would expect to have the knowledge set out in the Fluid Power Handbooks, being able (among other things) to draw hydraulic circuit diagrams and analyse them appropriately. I was shown a textbook, "Hydraulic and Electro-Hydraulic Servosystems" by Walters, which was published in 1967 and was available to Mr Riley, who is the engineer with the defendants presently responsible for resolving technical problems in production of the infringing PTU in its present form. Mr Riley, who has a degree in engineering from Cambridge, produced Walters and another book called "Mobile Hydraulics Manual" by Basal, also published in 1967, from the shelf of his colleague with whom he presently shares a room at the defendants' office in Bedhampton, Hampshire. These volumes were produced for the purpose of elucidating a dispute between Professor Watton on the one hand and Mr Lattimore on the other as to the meaning of the term "servovalve" at the priority date. This issue relates to the disclosure of the lecture to which I shall come. For present purposes, the references are useful because they give some insight into the sort of information that can properly be regarded as common general knowledge in the present case: if not carried around in the head of the skilled person, they are the sort of ordinary works of reference that one would expect the skilled person to use in his or her ordinary everyday work. They satisfy the requirement identified in *General Tire v. Firestone* [1972] RPC 457 at 483 as they are "generally regarded as a good basis for further action". Basal is a Vickers publication and is used for training within the organisation. Another example is a book called "Hydraulic Pumps and Motors – Selection and Application for Hydraulic Power Control Systems" by Lambeck, produced by Mr Lattimore. Professor Watton had his own copy, suggesting strongly that this is a widely used textbook. For present purposes, its interest is that it contains a description (page 143) of an arrangement in which a spool valve is used to provide a pump/actuator displacement proportional to applied pressure. I shall return to this citation later. I am more concerned at this point merely in identifying the level of attainment to be expected of the engineer in question. My impression, finally, was that much of the design in this area is conceptual. The translation of the conceptual design into steel is no doubt difficult and complex. Matters such as oil sealing, the shapes of ports and design principles appropriate to high hydraulic pressure are all matters that it no doubt takes years to acquire. Nevertheless, it is possible to see in these books what I would call (but none of the witnesses did) a sort of cookbook approach: problems that have been solved, and circuits that might be useful for a given application, are described in large numbers.

55. With this brief introduction to the common general knowledge, I can turn to the contents of the lecture itself.

The Vickers Lecture

56. A word first about context. At the beginning of the 1980s, Airbus was a consortium involving companies from a number of European countries. Deutsche Airbus was the umbrella organisation for the German members of the consortium. Messerschmitt-Bolkow-Blohm ("MBB") was part of Deutsche Airbus. Dr Carl gave evidence as to the structure of MBB and its function in developing specific technical specifications for the general architecture produced by Aerospatiale, the principal design authority.

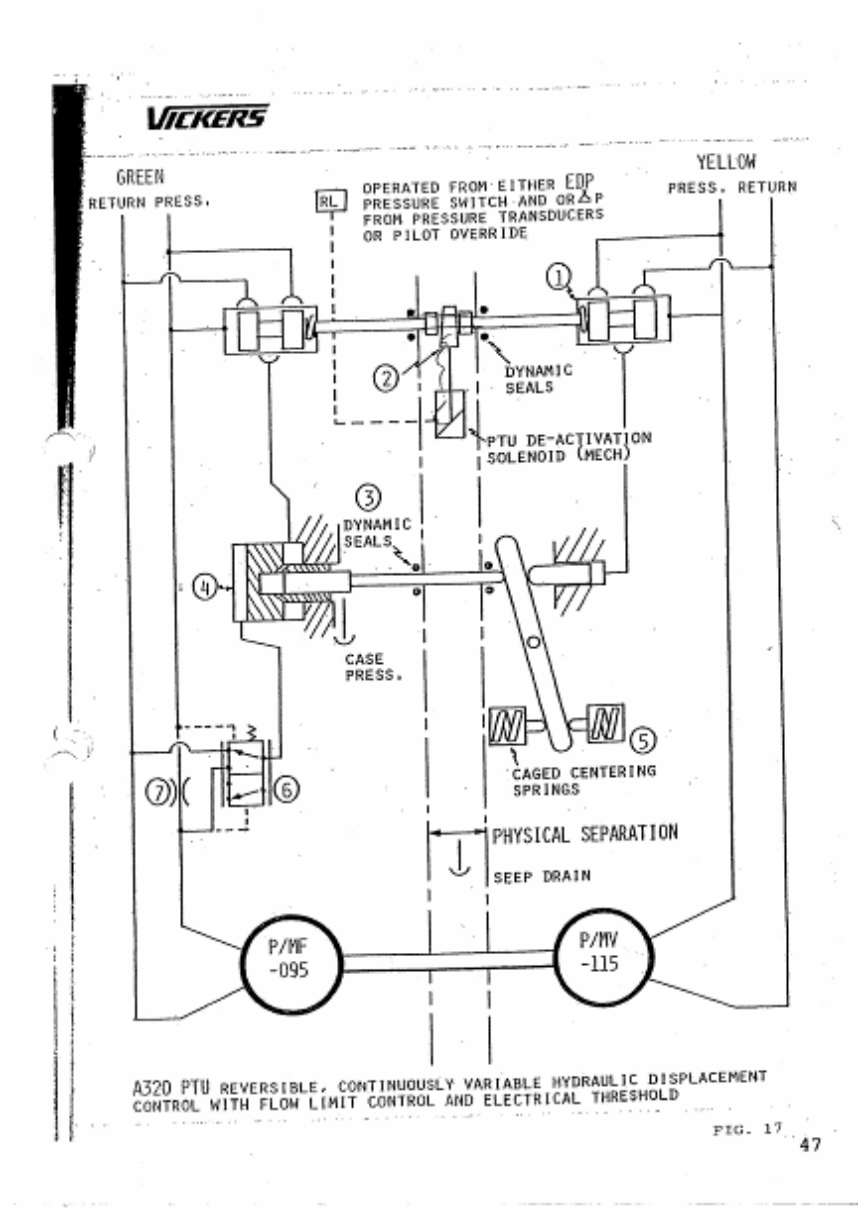
57. The technical specification for the A320 PTU (no. 2910MIE000100 issue 1) was circulated after discussions between MBB, Vickers and perhaps others as well about the overall requirements for the PTU. MBB employed many engineers: Dr Carl, who

gave evidence before me and was at MBB at the time, had responsibility for 150 of them. The technical specification to which I have referred was sent to all the specialists in this field. The essential architecture is described in section 2.2.1 set out above (para 8). That is the major part of the material disclosure in this document, but it should be noted that figure 1 is not specific as to the mode of control of the PTU.

58. Mr Silverleaf QC observes that this publication is fatal to the validity of unamended claim 1, and in this I think he is correct. He observes also (and there was cross-examination on the subject) that while the document requires a failure rate per flight-hour for internal leakage between the hydraulic systems of 10^{-7} – see paragraph 3.1.1 – the requirement of the claim is absolute. In my judgment, it is clear that any system complying with this requirement will properly be described as operating "without mixture of their respective fluids" in the only meaningful sense, since oil that goes to waste and is not returned to one or other of the hydraulic circuits cannot, I think, sensibly be viewed as being relevant for this purpose.

59. In the result, this document, which sets the scene for all the events following, clearly destroys the novelty of unamended claim 1.

60. As I have indicated, there is no detailed description of the control system, and, moreover, the natural reading of the bullet-points that I have listed above is that the system is essentially a three-position system. Either the variable-displacement unit has maximum displacement or minimum displacement, and its operating mechanism (the yoke) is spring-centred. The evidence was that at this stage MBB had no particular control mechanism in mind. Internally within MBB, electro-hydraulic control, electro-mechanical control and hydraulic control had all been suggested. Vickers responded to the technical specification with a proposal prepared by Mr Hamey and Mr Barrow. The system proposed (see particularly paragraph 5.1.3 of the proposal) was a hydro-mechanical system illustrated in figure 17 (below).

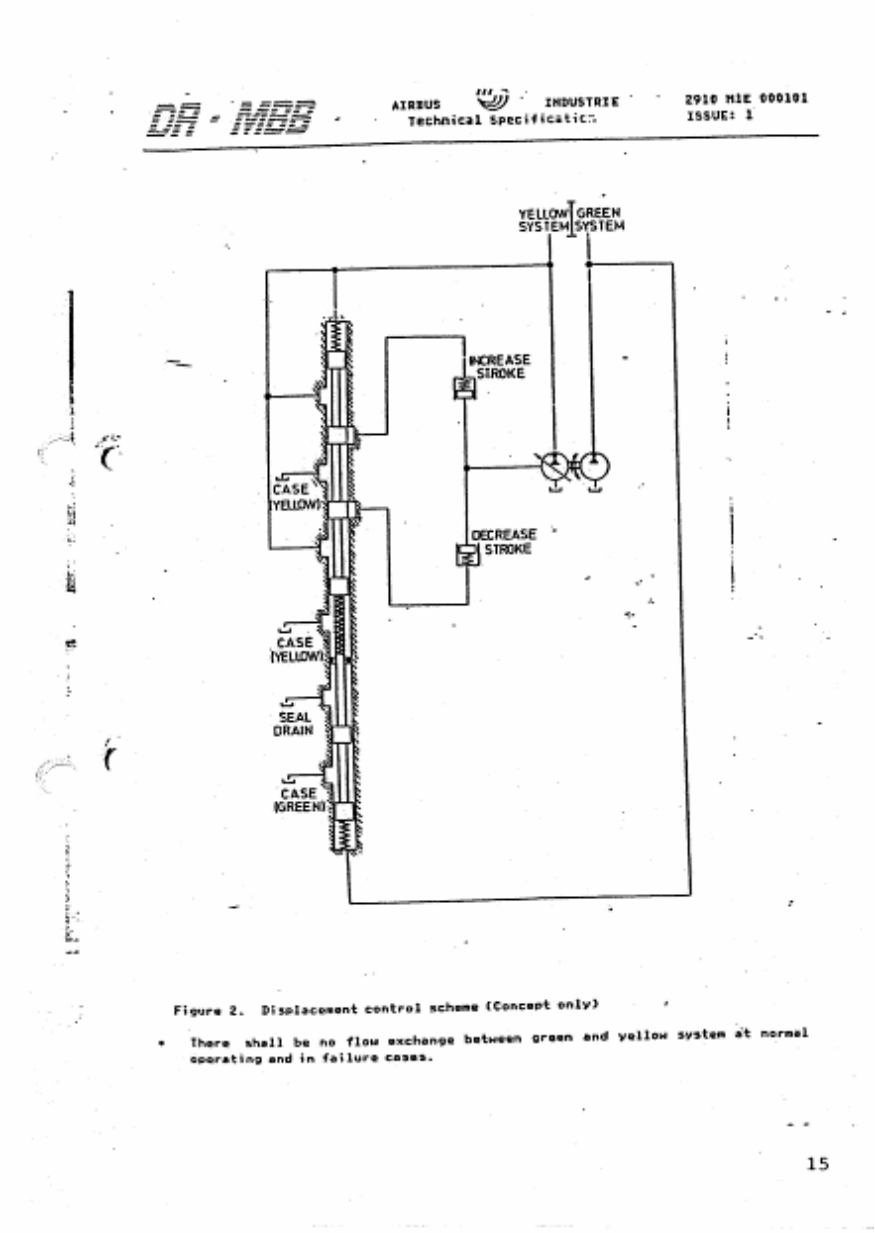


61. This system involves two spool valves separated by seals arranged so that the spool valves move in a direction determined by the pressure differential between the yellow and green systems. The whole is arranged so that for present purposes it is only necessary to note that the actuator is driven at its opposite ends by the pressure of whichever hydraulic circuit, green or yellow, is "supplying". Other criticisms were made by Professor Watton of the proposal, but it turned out in cross-examination that he had given a very precise interpretation to the circuit diagrams for the spool valves, essentially an interpretation that would involve the system as described not working. This was inappropriate for a sketch of this description, and this proposed control system reveals that a skilled person might well have thought of hydraulic actuation of the swashplate adjustment mechanism.

62. The difference between the claimed configuration and that shown in this diagram is essentially that while the spool valves in the patented arrangement are still operated by the pressure difference between the green and yellow circuits, they both serve to

distribute hydraulic fluid from the yellow side alone to one or other side of the actuating mechanism.

63. After proposals had been received, MBB sent out a second specification. The copy issued to Vickers was a redacted version of the copy issued to Garrett, the proposals in the Garrett document being considered to be confidential to Garrett and MBB. This much, I think, was clear from the evidence of Dr Carl. By this stage, Garrett had, in outline, devised the system called for by the patent, as their version of the specification demonstrates. The whole thing is shown quite economically in figure 2 of that document, which I believe to describe the whole of the essential part of the proposal.



64. Figure 2 (above), showing the Garrett proposal, was not supplied to Vickers when the revised specification was sent out on about 10th January 1985. The Fluid Power Conference took place in May 1985. The whole event is recorded in the pleaded minutes and was devoted to hydraulic features of the A320. Dr Carl and Mr Besing

from MBB presented the "hydraulic power generation system of A320 aircraft". The PTU is described between pages III-28 and III-32. Dr Carl says that care would have been taken not to disclose Garrett's particular design of PTU. The features of the PTU as described are as follows (in this summary I have omitted to mention irrelevant features also referred to):

- Consists of one variable displacement motor-pump connected to the yellow system and one fixed displacement motor-pump connected to the green system.

- Displacement control by a hydraulic/mechanical device.

- The power transfer in both directions is controlled by a pressure-controlled spool valve. This valve controls the actuation system of the variable displacement motor connected to the yellow system.

- There is no fluid transfer between the two systems possible under normal conditions and in failure case.

- Yellow to green power transfer: the variable displacement unit operates at max displacement.

- Green to yellow power transfer: the variable displacement unit operates at min displacement.

65. Mr Burkill QC submits that the use of the term "hydraulic/mechanical device" does not exclude electro-hydraulic or electro-mechanical control. I am not impressed by the suggestion that it is not a natural interpretation of the words used that the whole control system is hydraulic. What I think is more problematical is whether there is a sufficiently clear pointer to the use of the pressure of the yellow system only in the actuation system of the variable displacement motor. Mr Silverleaf QC submits that if systems of the kind shown in figure 6-16 of Lambeck are properly to be viewed as common general knowledge, then this mode of controlling the displacement is obvious as a matter of common general knowledge, although it is not by any means the only obvious interpretation to place upon the notes of the lecture. I found the evidence of both experts on this question curiously inconclusive. I was unimpressed by Professor Watton's very broad view of the disclosure, so broad as to encompass electro-mechanical means of control: Mr Lattimore made the very valid point that such an arrangement was certainly the simplest, and he rather dismissed Vickers' own effort shown in figure 17 above, on the grounds of excessive complexity. It is this design which Mr Silverleaf's submission that there is more than one obvious way of interpreting the minutes of the lecture is intended to avoid. It might equally well be asked why it is that, if the use of the pressure of one circuit only to drive the actuating mechanism is both obvious and simple, it did not occur to Vickers first.

66. Against this, Mr Burkill QC attempted to suggest that in fact the whole arrangement had been so unobvious to Vickers that they copied the design arrived at by Garrett. The medium for this copying was said to be a meeting that took place on 11th June 1985, and a note of this meeting – primarily concerned with the differences between the two specifications – says this:

> "Control system, method (hydro-mech) is to be shown.
>
> Garrett have a single side of centre actuation system (presumably in the yellow system) but with "both circuit" sending. The advantages of this approach are:-
>
> 1) Reduced cross-connections between systems.
>
> 2) Possible weight reduction.
>
> Possible disadvantages:-
>
> 1) High break-out differential in the event of rapid loss of pressure in the yellow system.
>
> 2) High response control stability needed to catch decaying pressure could give problems.
>
> Besing would appear not to have firm preference but system interleakage is important. Our proposal should include a cross-sectional diagram of our conceptual approach."

67. Mr Burkill then submits that the first records of Vickers considering a design in which the spool valve ported only pressure from the yellow system to both actuated pistons postdate this note. I was very unimpressed by all this. If an allegation of copying is to be made in support of a suggestion that an alleged invention is not obvious, then ordinary principles require that clear notice be given in the pleadings that an allegation of copying is going to be made. Neither the disclosure nor the witness statements were prepared with a view to meeting such an allegation. It does not help.

68. What is more interesting is that the design eventually arrived at by Vickers was not the same as the only design ever arrived at by Garrett, which is the preferred embodiment of the patent in suit. As I have described above, the allegedly infringing design does not employ springs for centring the activation jack, but uses direct mechanical feedback from the activation jack to the spool, to ensure that after break-out the actuator operates proportionately to the pressure difference between the two circuits. The type of mechanical feedback is precisely analogous to the mechanical feedback shown in figure 6-16 of Lambeck, and Mr Silverleaf submits that this is, in effect, another example of adding a known control mechanism to a back-to-back fixed- and variable-displacement pump motors. I think that this approach, though attractive, is flawed, because one is here dealing not with what I would call two machines (as in the celebrated sausage-machine case *Williams v. Nye* (1890) 7 RPC 62; and see *Sabaf v. MFI* [2004] UKHL 45) but rather with two parts of a single machine operating in a known way. After all, the back-to-back motors are no use without their control system, and the same could not possibly be said of the meat-grinder and the sausage-filler. My mind has wavered on this question, but I am not persuaded that on the material available the alleged invention is obvious. I was left in the end with the feeling that the approach to this question involved an unacceptable risk of hindsight employed for the improper purpose of dissecting the invention into its component parts, together with a careful demonstration that each of the component parts was itself old or an obvious building-block to use. Oddly, I am not certain that

the same criticism could be made of an allegation that the alleged infringement was inventive at the priority date. As I am satisfied that Lambeck represents the common general knowledge, and since there is a clear illustration in Lambeck of the use of positional feedback to vary the displacement of a variable-displacement pump, I think, for what it is worth, that there is a rather better case that the alleged infringement was an obvious way of implementing a PTU in accordance with the general disclosure of the Vickers lecture. In forming this view, I do not think that I have applied different criteria. The advantage of the Lambeck example is that it drives home the manner in which proportional operation is to be achieved by the use of a single spool valve. I am completely unpersuaded that it would not be obvious to the skilled person how to ensure that when the spool valve was operated by the pressures in two different hydraulic circuits, to keep the operative pressure-sensing portions of the spool well separated by seals and drain to waste. If the claim covers this arrangement, and I think that it does, I think that the attack of obviousness from this direction is rather more difficult to meet than an allegation of obviousness of the preferred embodiment in the light of the common general knowledge. For this reason, I would conclude that the claim, if wide enough to cover the alleged infringement, would be invalid for obviousness.

Conclusion

69. In the result, the patent is invalid. The proposed amendments are not acceptable, but, if made, the claim is invalid if it covers the alleged infringement.