

# UK Patent Application

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(72) Inventor(s): Thomas Richard Burrow Heinrich Firgo		(58) Field of Search:	UK CL (Edition X) <b>A3V, D1K, D1R</b> INT CL <sup>7</sup> <b>A41B, A41D, B32B, D03D, D04B, D04H</b> Other:
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(54) Abstract Title: **Wicking fabric**

(57) A moisture wicking fabric has one side 1,10 comprised substantially entirely of inherently hydrophobic fibres such as polyester or polypropylene and the other side 2,12 comprised of a mixture of hydrophobic fibres such as polyester or polypropylene and hydrophilic fibres, particularly cellulosic fibres such as cotton, lyocell and viscose rayon. A garment can be formed from such a moisture wicking fabric, for example by the whole garment knitting method, the side comprised of the mixture of fibres being the external side of the garment.

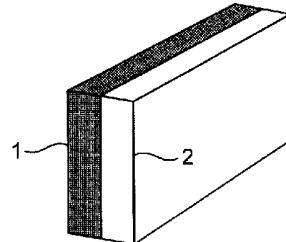


FIG. 1

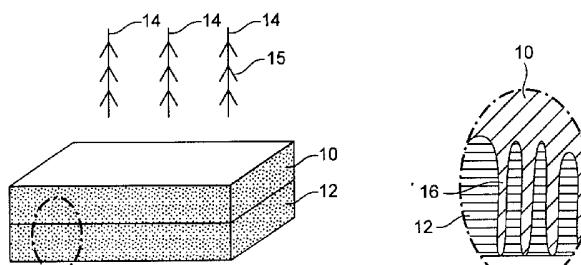


FIG. 5

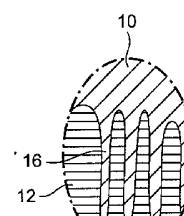


FIG. 6

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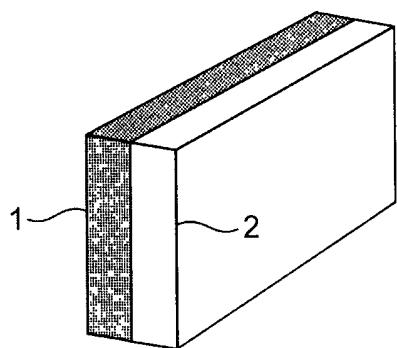


FIG. 1

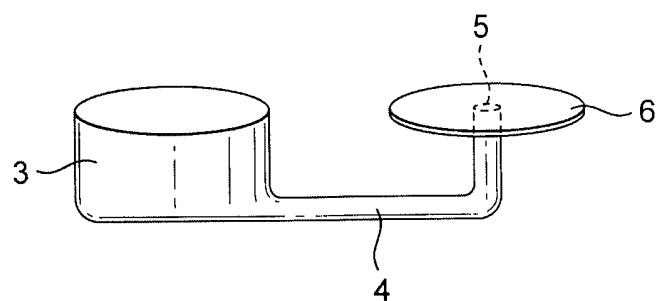


FIG. 2

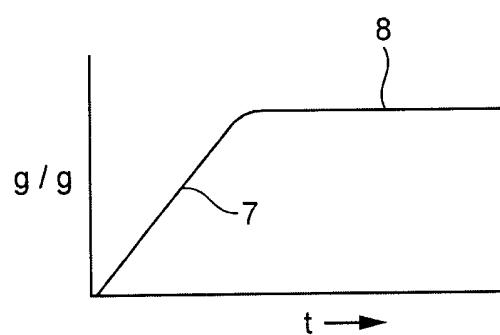


FIG. 3

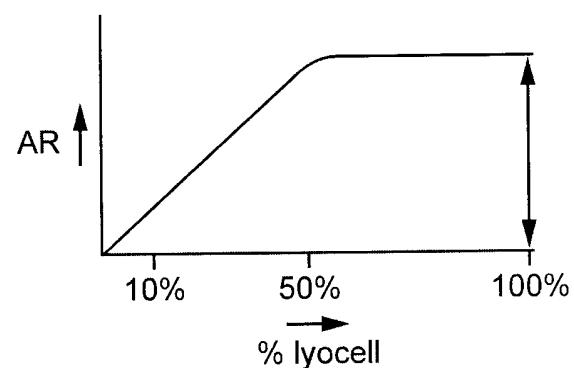


FIG. 4

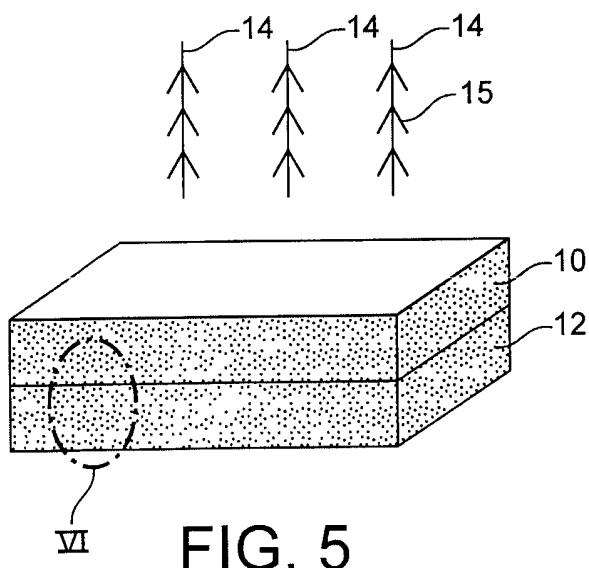


FIG. 5

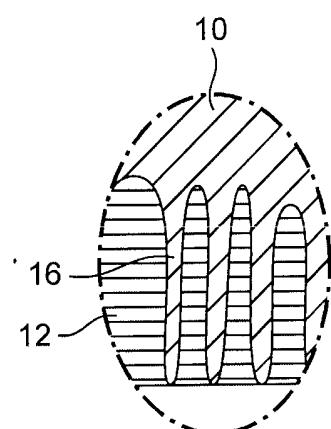


FIG. 6

WICKING FABRIC

This invention relates to wicking fabrics and has particular reference to wicking fabrics containing lyocell and/or other cellulosic fibres. It also relates to garments formed of such 5 wicking fabrics.

There is a considerable demand for technical or active fabrics, particularly for use in sportswear or other applications, where moisture is required to be transported rapidly and comfortably from one side of the fabric to the other and then to be spread 10 over a wide surface area to maximise the cooling effect due to evaporation. Such fabrics are then also faster drying than normal fabrics.

These technical fabrics not only need to be effective in terms of their wicking abilities but they also preferably need to be 15 comfortable in use. Ideally such fabrics, when made up into garments, feel drier on the inside of the garment than on the outside. They are also preferably not too heavy to the extent that they feel uncomfortable in use.

In one form of known prior art the fabrics are made of 20 polyester produced in two layers, with an inner layer being completely formed of a hydrophobic form of polyester and the outer layer being formed of treated polyester which is hydrophilic. These hydrophilic treatments are applied as chemical treatments to the polyester, and unfortunately it has 25 been found that the fabrics lose their hydrophilic treatment on washing and they therefore deteriorate from both a comfort and a technical performance viewpoint.

Hydrophobic materials may be weakly hygroscopic, such as 30 polyesters and polyacrylonitriles, which have a low water retention of less than about 25%, or non-hygroscopic, such as polypropylene, polyvinyl chloride or polyethylene.

Hydrophilic materials tend also to be strongly hygroscopic, such as cellulose or wool.

It has also been proposed in published US Patent Application 2004/0058072 to produce fabrics from yarns in which there is a 5 first yarn of cellulosic fibres, part at least of which is treated with a hydrophobic treatment, and a second yarn of cellulosic fibres with a higher absorbent capacity than the first yarn, the fabric being produced by knitting or weaving together the first and second yarns so that the inside surface 10 has a lower absorbent capacity than the outside surface.

Again, these types of processes involve the chemical treatment of the fibres to give the desired effect, and such chemical treatments are not permanent and wash off in use.

It has now been discovered that it is possible to produce 15 technical wicking fabrics from fibres which do not require chemical treatment to be effective.

The present invention provides a moisture wicking fabric having one side comprised substantially entirely of fibres of an inherently hydrophobic material and the other side comprised of 20 a mixture of fibres of an inherently hydrophobic material and hydrophilic fibres, especially cellulosic fibres.

The invention also provides a moisture wicking fabric having one side comprised substantially entirely of fibres of an inherently hydrophobic material and the other side comprised of 25 a mixture of fibres of an inherently hydrophobic material such as a synthetic or plastics material and hydrophilic fibres such as cellulosic fibres, whereby the fabric of the one side is more hydrophobic than the fabric of the other side.

An inherently hydrophobic material is one, such as a polyester, 30 a polyamide or a polypropylene, which has a water imbibition or retention of less than 25%.

Preferably the inherently hydrophobic plastics material is a polyester. The fibres of the inherently hydrophobic material, e.g. plastics materials, on the one side may be formed of the same material as the fibres of the inherently hydrophobic material, e.g. plastics materials, on the other side or of a different material.

Preferably, the mixture of hydrophilic, especially cellulosic, fibres and fibres of an inherently hydrophobic material, e.g. plastics material, contains less than or not more than 50% of the hydrophilic, especially cellulosic, material. Preferably, the cellulosic material is lyocell, but it is also possible to use other cellulosic materials or mixtures of lyocell fibres with cellulosic materials of one or more other types, for example in lesser amounts. Typically and preferably the content of lyocell and/or other cellulosic material is in the range 10 50%, preferably 20 to 40% and further preferably about 30%. Staple fibres and/or continuous filaments can be used in the layers.

The fabrics may be produced by knitting or weaving or by non-woven bonding techniques such as needle-bonding. A preferred method of manufacturing the fabrics is by a knitting process, with a double jersey knitting process being used to produce the two layers simultaneously, the layers being interlinked by a linking thread so as to be in intimate contact.

A further method of producing the fabrics is by needle-bonding in which a layer of air-laid polyester or other hydrophobic fibres is laid over a layer of air-laid lyocell and/or other cellulosic fibres, and the two layers are needle-punched together, with the needles entering from the polyester side and needle barbs being directed so as to force the polyester fibres into the lower layer of the lyocell and/or other cellulosic fibres so as to produce on one side substantially wholly

polyester and on the other side a mixture of polyester and lyocell and/or other cellulosic material.

The invention further provides a garment formed from the fabric set out above in which the inner side of the garment comprises the substantially entirely (100%) hydrophobic layer and the outer side comprises the mixture of fibres, e.g. hydrophobic fibres and cellulosic fibres. The garment may be produced by a whole garment knitting process, whereby the garment is knitted to shape as a double jersey product in a single operation.

10 Embodiments of the present invention will now be described with reference to the accompanying drawings, of which

Figure 1 is a schematic sectional view of a fabric in accordance with the present invention,

15 Figure 2 is a schematic representation of a modified gravimetric absorbency testing system (GATS),

Figure 3 is a graph of absorbency against time,

20 Figure 4 is a graph of absorbency rate against percentage lyocell in a mixed lyocell/polyester material,

Figure 5 is a schematic view of a needling system, and

25 Figure 6 is an enlargement of the portion within the oval VI of Figure 5.

Technical fabrics, particularly wicking fabrics suitable for uses such as sportswear, have to perform a number of processes and also have to have a good balance between aesthetics and 30 performance. For example, sportswear formed of 100% polyester fabric is able rapidly to wick moisture from the inside of the fabric adjacent the wearer's skin to the outside. However, 100% polyester fabrics feel uncomfortable and retain virtually no water in the fabric.

In particular, the fabrics only 35 transport water from the inside to the outside and the transported moisture does not spread sideways. Thus, in regions of high production of moisture such as in the central

regions of the spine and under the arms there is a rapid build up of water in and on the fabric, which gives an uncomfortable feel to the fabric and means that the fabric dries only slowly.

Proposals have been made to form polyester sportswear from two 5 layers, an inner layer of 100% hydrophobic, i.e. untreated, polyester and an outer layer of fabric formed from treated polyester which has been treated to make it hydrophilic. However, such treatments are normally applied as finishes and these finishes wash off with repeated washings. Furthermore, 10 these fabrics still have the feel or "hand" of synthetic fibre fabrics and have the normal properties of 100% polyester fabrics, namely they are prone to pilling and the build-up of static electricity.

100% cellulosic fabrics on the other hand have a different sort 15 of problem. The water or moisture absorbency of these cellulosics is so high that the water does not spread and the fabric tends to feel wet, heavy and clammy.

Cellulosic fibres also tend to be more expensive than polyester fibres, and, therefore, the cost of the fabrics and hence of 20 the garment tends to be greater.

The present invention, as illustrated in Figure 1 of the drawings, provides a moisture wicking fabric which is particularly suited to technical applications such as sportswear. The fabric comprises a two-layer structure, 25 preferably one side of which (1) is formed almost entirely of fibres of an inherently hydrophobic plastics material such as polyester and the other side of which (2) is formed of a mixture of lyocell fibres and fibres of an inherently hydrophobic plastics material. Other cellulosic fibres such as 30 cotton, modal or viscose rayon fibres could be used instead of or in addition to lyocell fibres, but lyocell is preferred for its combination of feel and strength, particularly wet strength.

Such a fabric produces garments which are comfortable to wear and have a high moisture wicking characteristic.

It has been particularly found that, if the layer (2) comprises a mixture of inherently hydrophobic plastics material fibres 5 formed of polyester together with 10 to 50% by weight of lyocell, a fabric is produced which has permanent wicking properties which are not reduced by repeated washing.

To enable an understanding of the invention to take place, set out below is background information on the absorbency of 10 fabrics, which information demonstrates the particular benefit to be obtained by using a fabric containing 10 to 50% by weight of lyocell in a polyester mix for the layer (2) referred to above.

One known method of testing the absorbency of fabrics is the 15 so-called Gravimetric Absorbency Testing System (GATS). Details of such a system are given in the journal "International Nonwovens Journal", Volume 11, No.4, Winter 2002, in the article by Konopka and Pourdeyhimi and Kim entitled "In-Plane Liquid Distribution of Nonwoven Fabrics: 20 Part I - Experimental Observations", particularly pages 23 to 25. Essentially, the Gravimetric Absorbency Test utilises apparatus shown schematically in Figure 2 of the drawings, comprising a reservoir (3) for water connected by a U-tube (4) to an outlet point (5). A disc (6) of fabric to be tested is 25 applied over the outlet (5) so that the material of the disc (6) takes up water from the reservoir via the U-tube (4) by capillary action. However, only fabrics which absorb water will "suck" liquid into them.

Shown in Figure 3 of the drawing is a graph of absorbency on 30 the vertical axis in terms of grams of water absorbed per gram of fabric against time in seconds on the horizontal axis. Essentially, the fabric absorbs water during an absorbency phase illustrated by the first portion (7) of the line of the

graph until it reaches a steady state illustrated by the second portion (8) of the line of the graph. The steeper the slope (7) the greater the absorption rate of the fabric and therefore the better and quicker the fabric will absorb water. The value 5 of the height of the steady-state line (8) is an indication of the total capacity of the fabric to absorb water. A series of tests was carried out to determine the wicking rate of the fabrics in terms of grams of water absorbed per gram of fabric per second (g/gs). The tests were carried out using various 10 polyester/lyocell fabrics, varying from 100% polyester fabrics of untreated polyester fibre to 100% lyocell fabrics utilising increasing amounts of lyocell. The results of these tests are set out in Table 1.

15

Table 1

% lyocell in lyocell/polyester mix	Wicking Rate (g/gs)
0	0
10	0.06
20	0.16
30	0.267
40	0.4
50	0.444
100	0.444

From these tests the absorbency rate for the different fabrics was plotted against the proportion of lyocell. This gave rise 20 to the graph illustrated in Figure 4 of the drawings, where the absorbency rate (AR) is measured on the vertical axis and the percentage of lyocell in the polyester/lyocell fabric mixture is measured on the horizontal axis.

It can be seen from this that the absorbency rate initially increases as more lyocell is incorporated into the fabric to

reach a maximum at about 50%. Beyond 50% the absorbency rate does not increase any further.

Without prejudice to the invention, the reason for this behaviour is now believed to be because, when only a small proportion of the fibres are cellulosic (e.g. lyocell), there is unlikely to be a continuous path consisting of cellulosic fibres for the water to follow. However, when there is sufficient cellulosic fibre present the water can travel through the fabric following a continuous path of cellulosic fibres. Once each cellulosic fibre is in contact with many neighbouring fibres, a further increase in the proportion of cellulosic fibres will not give any increase in wicking.

This unexpected discovery has led to the present invention in which the layer 2 of the fabric comprises a mixture of lyocell (and/or other cellulosic) and polyester (and/or other synthetic). It has specifically been found that, by having the layer 2 as a mixture of polyester and lyocell, rather than 100% lyocell, water being wicked through from the polyester layer is encouraged to spread sideways through the layer 2 rather than accumulate in one place as would be the case if the layer 2 were 100% lyocell.

The lyocell in the layer 2, by wicking water away from layer 1, enhances the transpiration of the layer 1 and helps prevent garments made from the fabric feeling uncomfortable in use. It has been found by observation that water can move sideways in preferred layer 2 according to the invention at a rate of about 7.5 cm in ten seconds. This means that in less than a minute the water can move almost half a metre, in other words virtually across the entire body of a person wearing a shirt made from such a fabric. This means that, in garments formed from fabrics according to the invention, water generated in areas of high perspiration such as around the spine and under the arms can be wicked sideways in the layer 2 to enhance the

comfort of the sportswear made from such a fabric. Furthermore, the surface area containing large quantities of moisture is increased by this lateral wicking, thereby enhancing the evaporation rate of the garment as a whole.

5 Because polyester fibres are lower in weight than lyocell the fabric as a whole can be kept as a low-weight fabric, again further enhancing the comfort of the wearer.

It will be appreciated that there are many ways of making the two-layer structure, in particular the layers 1 and 2 can be

10 woven together or they can be knitted by a double jersey knitting process such as is described in US Patent 5,209,084, utilising knitting machines such as are described in the book "Dubied Knitting Manual", published by Edouard Dubied and Cie SA, Switzerland, in 1967.

15 By this means the layers 1 and 2 can be created simultaneously and interconnected simultaneously from yarns of polyester alone for layer 1 and a polyester/lyocell mixed yarn for layer 2.

Another way of manufacturing the fabric is to needle-bond together two nonwoven webs. As illustrated in Figures 5 and 6

20 of the drawings, a first web 10 of air-laid polyester staple fibre or air-laid polyester continuous filament is laid on top of a second layer 12. The layer 12 is an air-laid bat or mat of fibres formed from a mixture of lyocell and polyester. The two layers are then needled together by needles such as 14

25 which have downwardly directed barbs such as barb 15. This pushes the fibre from the upper layer 10 into the lower layer 12, as is shown more clearly in Figure 6. Because the barbs 15 are downwardly directed, the needles tend only to push the layer 10 downwards and to a much lesser extent pull the layer

30 12 upwards. There is, therefore, formed a bonded structure comprising an upper layer 10 of polyester and a lower layer 12 which comprises a mixture of lyocell and polyester fibres in conjunction with additional polyester fibres pushed from layer

10. Fingers 16 shown in Figure 6 pushing the layer 10 into the layer 12 can carry some of the polyester right through the layer 12 onto the bottom of layer 12.

In a modification of this process the layer 12 can consist  
5 entirely of lyocell fibres in the unneedle-bonded condition. This results in a mixture of lyocell and polyester as shown in Figure 6 which is slightly less intimately bonded than the mixture produced by starting with yarns of polyester and lyocell fibres in the layer 12.

10

Clearly, where the layer 12 is initially a blend of polyester and lyocell, the initial lyocell content in layer 12 will be greater than the lyocell content in the layer after needle-bonding, and an appropriate allowance should be made, depending  
15 on the ultimate lyocell content desired for the layer 12.

A further advantage of the present invention is that the knitting process used to form the two layers can be used to knit a complete garment in a single operation by the known  
20 whole-garment knitting process, so that the garment is made in one go from a polyester or other hydrophobic inner layer and an outer layer comprising a blend of polyester and cellulosic, typically lyocell, fibre.

25 Although the specific examples of the invention have been described with reference to lyocell and polyester, other hygroscopic fibres and fabrics such as other cellulosic fibres including viscose, modal and cotton could be used, or even wool.

30

The hydrophilic materials include those which are non-hygroscopic or weakly hygroscopic.

Claims

1. A moisture wicking fabric having one side comprised substantially entirely of inherently hydrophobic fibres and the other side comprised of a mixture of hydrophobic fibres and hydrophilic fibres.
2. A moisture wicking fabric as claimed in claim 1 in which the fabric of the one side is more hydrophobic than the fabric of the other side.
3. A moisture wicking fabric as claimed in claim 1 or 2 having one side comprised substantially entirely of fibres of an inherently hydrophobic synthetic or plastics material and the other side comprised of a mixture of fibres of an inherently hydrophobic synthetic or plastics material and hydrophilic fibres.
4. A moisture wicking fabric as claimed in any one of claims 1 to 3 in which the hydrophilic fibres are cellulosic fibres.
5. A moisture wicking fabric as claimed in claim 4 in which the cellulosic fibres are selected from cotton, lyocell and viscose rayon.
6. A moisture wicking fabric as claimed in any one of claims 1 to 5 in which the inherently hydrophobic material is selected from polyester and polypropylene.
7. A moisture wicking fabric as claimed in any one of claims 1 to 6 in which the fibres of the inherently hydrophobic material on the one side are formed of a different material from the fibres of the inherently hydrophobic material on the other side.
8. A moisture wicking fabric as claimed in any one of claims 1 to 6 in which the fibres of the inherently hydrophobic

material on the one side are formed of the same material as the fibres of the inherently hydrophobic material on the other side.

9. A moisture wicking fabric as claimed in claim 4 or 5 or  
5 in any one of claims 6 to 8 appendant to claim 4 or 5, in which the layer formed of the mixture of fibres contains not more than 50% cellulosic fibres and not less than 50% of fibres of an inherently hydrophobic plastics material.
10. A moisture wicking fabric as claimed in claim 9 in which  
10 the layer formed of the mixture of fibres contains 10 to 50%, preferably 20 to 40% and further preferably about 30%, of cellulosic fibres.
11. A moisture wicking fabric as claimed in claim 9 or 10 in  
which the cellulosic fibres are lyocell fibres.  
15
12. A moisture wicking fabric as claimed in any one of claims  
1 to 11 in which the two layers are joined together by  
knitting, weaving or needle bonding.
13. A moisture wicking fabric as claimed in claim 12 in which  
the two layers are joined together at the same time as  
20 they are created by weaving or knitting.
14. A moisture wicking fabric as claimed in claim 1 and  
substantially as hereinbefore described or illustrated.
15. A garment formed of a moisture wicking fabric as claimed  
in any one of claims 1 to 14 wherein the side comprised  
25 of the mixture of fibres is the external side of the  
garment.
16. A garment as claimed in claim 15 which is a knitted  
garment knitted by the whole garment knitting method.



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**Application No:** GB0519462.6

**Examiner:** Alex Littlejohn

**Claims searched:** 1-16

**Date of search:** 8 December 2005

## 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	1-11	WO 98/24621 A (Weyerhaeuser) see whole document, e.g. pages 5-8, especially page 7 lines 23-25
X	1-7,9-12,15	US 5433987 A (Peterson) see whole document, e.g. col 2 line 67 - col 4 line 11
A	-	US 2003/0181118 A (Ko) see whole document, e.g. claim 1
A	-	US 5787503 A (Murphy) see whole document, e.g. col 4 lines 15-36
A	-	US 5735145 A (Pernick) see whole document, e.g. col 4 lines 1-63
A	-	US 5297296 A (Moretz) see whole document, e.g. col 5 line 61 - col 6 line 35

### Categories:

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<sup>X</sup>:

A3V; D1K; D1R

Worldwide search of patent documents classified in the following areas of the IPC<sup>07</sup>

A41B; A41D; B32B; D03D; D04B; D04H

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

EPODOC, WPI