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(54) Method for monitoring the operation in an insertion brake

(57) The present invention relates to a method for monitoring the operation of an insertion brake (6) suitable for being used between a yarn preparing device (4) and a loom (R), comprising a movable brake element (21) which is movable between a position of rest on one side of the yarn (1) and a braking position on the other side of the yarn (1), wherein the brake element (21) is coupled to an electric driving motor (23) via a shaft (22), wherein the acceleration of the shaft (22) and the parts connected thereto is determined with every stroke of the brake element (21), and if the measured value is higher than or lower than a specified value, a signal indicating this will be generated.

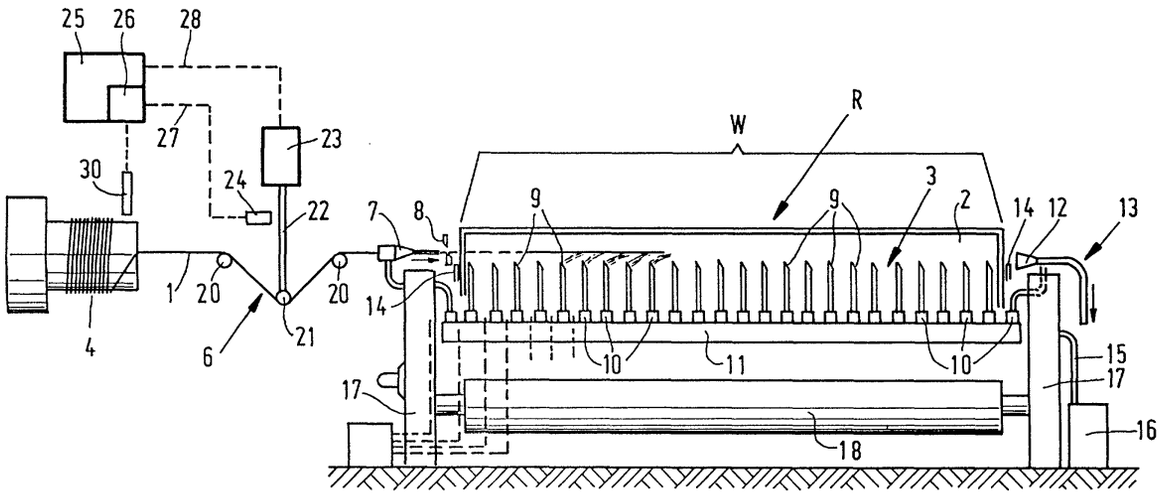

FIG.1

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Description

[0001] The present invention relates to a method for monitoring the operation of an insertion brake suitable for being used between a yarn preparing device and a loom, comprising a movable brake element which is movable between a position of rest on one side of the yarn and a braking position on the other side of the yarn, wherein the brake element is coupled to an electric driving motor via a shaft.

[0002] An insertion brake of the kind to which the method according to the present invention relates is disclosed in the present applicant's International patent application WO 00/44970. Said known insertion brake is used for decelerating the yarn that is unwound at high velocity from a yarn preparing device for a loom at very precisely determined points in time. The movable element thereof, which is usually in the form of an elongated arm or fork which is coupled to the shaft of the electric drive unit, is moved from a position of rest on one side of the yarn to a braking position on the other side of the yarn. It is essential that the brake functions properly, and in order to be able to verify this, the aforesaid International patent application WO 00/44970 has already proposed a method according to which it is verified whether the element has made a specific stroke within a specific period of time.

[0003] In practice it has become apparent, however, that in extreme conditions, for example when the moving brake element hits an obstacle which unforeseeably moves into the path of movement of the element, a part of the brake element may break off. The brake element will no longer be in contact with the yarn in that case, as a result of which the braking action will be lost and badly woven fabric may be produced for some time. Accordingly, there is a need for a monitoring system which signals the occurrence of such a defect. The monitoring system as described in the aforesaid International patent application does not provide a solution in this regard, because it only measures whether the movable brake element has travelled a specific distance within a specific period of time, which fact will also be correctly signalled in case of a fractured brake element.

[0004] Accordingly, it is the object of the invention to provide a system for monitoring the operation of the insertion brake of a loom, in which a signal is generated which indicates whether the brake as such is still intact or not. In order to accomplish that objective, the method according to the invention is characterized in that the acceleration of the shaft and the parts connected thereto is determined with every stroke of the brake element, and if the measured value is higher than or lower than a specified value, a signal indicating this will be generated. During normal operation of the brake, the brake element and the parts of the drive unit connected thereto have a specific mass, which is moved with a specific acceleration when a specific voltage is applied to the motor. If the acceleration value is found to be lower than a specified minimum value, this in fact signals that the brake is not operating properly. If, on the other hand, the acceleration value of the brake element and the parts connected thereto is found to be higher than a specified value, this means that the acceleration is too high, which is normally a sign that the mass of the brake element has decreased, and that in all probability the brake element has fractured, therefore, as a result of which it can no longer function properly. If this happens, the loom will generate a specific signal, which either stops the loom or which signals to the user that something is wrong, so that the user can take adequate measures.

[0005] In another advantageous embodiment of the method according to the invention, the determination of the acceleration value takes place by establishing the distance between the position of rest and the position of the brake movement at a specific point in time as well as the maximum current or the average current that occurs during the movement between the position of rest and the position at said specific point in time, after which the quotient of the distance travelled and the maximum current is determined and a signal will be generated if a specified value is exceeded. In this way, a very good measure of the acceleration of the moving brake element is obtained, as will be explained in more detail hereinafter with reference to the drawing, and thus an adequate signal for determining whether the brake is properly functioning or not.

[0006] In another advantageous embodiment of the method according to the invention, the aforesaid position at said specific point of time in the path of movement of the moving brake element lies before the position at which the brake element normally comes into contact with the yarn. In this way, the yarn is prevented from influencing the measurement of the acceleration value of the moving element, and only the acceleration value of the brake element itself is measured, without the yarn having any influence thereon.

[0007] In this way, an adequate and simple method for detecting whether the brake element is functioning properly or not is obtained. The measured acceleration value may be too high, from which it can be concluded that the brake element has probably fractured or lost at least part of its mass, but the measured acceleration value may also be too low, which may be caused by fouling and/or wear, as a consequence of which the quality of the woven fabric will be poor.

[0008] The invention will be explained in more detail hereinafter by means of a exemplary embodiment, with reference being made to the drawing, in which:

Fig. 1 is a schematic front view of a loom;
Fig. 2 is a perspective, schematic view of an embodiment of an insertion brake; and
Fig. 3 schematically shows the change in the position of the movable element.

[0009] In an air jet loom R, a weft yarn 1 is fed from a

supply drum 4, via an insertion brake 6, to a main injector 7. The main injector 7 feeds the yarn 1 past scissors 8 to the shed 3 formed by the warp yarns 2, which has a width W. Auxiliary blow pipes 9, which are connected to a compressed air pipe 11 via magnetic valves 10, assist the transport of the yarns through the shed 3. After the end of the weft yarn 1 has left shed 3, it enters a funnel 12 of an extractor 13 and is cut off, with the two yarn ends being laid into selvedge devices 14 disposed on either side of the shed. The drawing furthermore shows that the compressed air pipe 11 is connected to a compressed air generator 16 via a pipe 15, whilst the drawing furthermore shows a drum 18 for the finished product, which drum is disposed between side walls 17.

[0010] The insertion brake 6 is built up of two fixedly disposed yarn guides 20, between which a movable brake element 21 is arranged. The movable brake element 21 is connected to a driving device 23 via a lever 22.

[0011] The insertion brake 6 furthermore comprises a sensor 24 for sensing the instantaneous position of the movable brake element 21. The loom furthermore comprises an electronic control device 25, which includes a programme section 26 in which at least one time-position programme for the movable brake element 21 is stored. The position detection sensor 24 continuously transmits the sensed instantaneous position of the movable brake element 21 to the electronic control device 25 via line 27, which control device compares said instantaneous position with the desired position in programme section 26, after which, in case of a difference between the sensed instantaneous position and the desired position, the electronic device varies the excitation of the driving device 23 via line 28, in such a manner that the sensed difference is at least substantially eliminated.

[0012] Furthermore, a stop element 30 acts on the supply drum 4, which stop element is pushed against the supply drum surface at the end of the insertion process, that is, when the end of the weft yarn has reached the end of the shed, so that further unwinding of the yarn from the supply drum is stopped.

[0013] One embodiment of an insertion brake which can be used in the loom according to Fig. 1 is shown in Fig. 2. This figure shows the way in which a lever 21 in the form of a fork is movable between two fixedly disposed yarn guides 20. The lever 21 includes a block 31 on its other side, which is mounted on a shaft 32 of a solenoid motor 33. The block 31 includes a magnet 34, which cooperates with a sensor 35. Although a solenoid electric motor is used for driving the movable brake element 21 in this embodiment, it will be apparent that also other types of electric motors can be used, it is even possible to use hydraulic or pneumatic motors.

[0014] A first stroke-limiting stop 41 is disposed on one side of the movable element 21, and a second stop 42 is disposed on the other side thereof. The position detection sensor 35 is furthermore connected to a schematically indicated electronic control device 25, which includes the aforesaid programme section 26 of the time-position programme as well as a control module 43 for adjusting the position of the position detection sensor 35 and a function verification module 44 for verifying the correct operation of the brake. Said verification does not comprise the detection of a possible change in the mass of the brake element, however, which might occur in case of fracture of the fork 21. In accordance with the invention, the function of the verification module has been extended in such a manner that said module will now also measure the acceleration value of the movable brake element 21, and if the measured acceleration value is higher than or possibly lower than a specified value, a signal will be generated which indicates that the brake is no longer functioning properly.

[0015] The determination of a value which is representative of the acceleration of the brake element 21 takes place as follows. The relation between the position and the acceleration of the brake element follows from the formula:

$$h(t) = \int \int a(t) \qquad (1)$$

wherein:

h is the position of the brake element at point in time t,
a is the acceleration at point in time t.

This formula can be converted into the following formula:

$$a = \frac{T(t)}{J} = \frac{K_m . I(t)}{J} \qquad (2)$$

wherein:

K_m = a motor constant,
I(t) = the current at point in time t,
J = the mass inertia moment of the moving brake element and the parts of the driving system that move along therewith.

From this formula it follows:

$$h(t) = \frac{K_m . C}{J} . I_{\max}(t) \text{ or } (C . \int I(t) = C . I_{avg}) \qquad (3)$$

Which gives:

$$\frac{K_m . C}{J} = \frac{h(t_3)}{I_{\max}(t_3)} \left(or \frac{h(t_3)}{I_{avg}} \right) \qquad (4)$$

from which it appears that a relation exists between the distance h travelled between the position of rest and the position at t_3 of the brake element and the maximum current that occurs during the period from t_0 to t_3. It has been assumed that a particular relation exists between the maximum current and the average over said period. This assumption is reasonable if the current exhibits a constant trend, which is generally the case if the brake element is driven in such a manner that its movement exhibits the same trend.

[0016] The movement of the brake element 21 starts from its position of rest P_0 at point in time t_0 until 1 its braking position P_2 at point in time t_2. The yarn position is indicated by dotted line G. If the mass inertia moment of the brake element 21 is high, i.e. normal, the brake element will follow the line 50 between P_0 and P_2, which means that its position at point in time t_3 lies at point P_3. If, in an extreme situation, a part of the arm 21 has broken off for some reason, the mass inertia moment thereof will have decreased considerably. This smaller mass inertia moment will cause the brake element to follow the path indicated by the dotted line 51 upon its movement from point P_0 (position of rest) to point P_2 (braking position), and consequently the position of the brake element at point in time t_3 will be P_3' in that case.

[0017] From this it will be apparent that the distance between h_0 and h_3 is smaller than the distance between h_0 and h_3', which means that the quotient of said distances and the maximum current I_{max} such as occurs in the range between t_0 and t_1 has become larger, and if this quotient exceeds a specified value, the module 44 will generate a specific signal, which either stops the loom or warns the user that something is wrong, so that the user can take adequate action. From the diagram it will be apparent that the range over which measuring takes place lies before the point at which the brake element has reached the yarn G. This means that the measurement is not influenced by the force which the yarn exerts on the brake element.

[0018] In this way it has become possible to obtain a reliable indication of the acceleration value of the movable brake element, and thus of the mass inertia thereof, without the addition of components to the loom being required. If the acceleration value rises too high, this means that the mass inertia moment has decreased to such an extent that it must be concluded that the brake element has fractured or that something else is wrong. Also the detection of an acceleration value lower than a specified value may be an indication that the brake element is not functioning properly.

[0019] In the foregoing, the maximum value of the current (I_{max}) has been used as the control magnitude. It is also possible to use the average value of the current (I_{avg}) while retaining the same operation and the same advantages.

Claims

1. A method for monitoring the operation of an insertion brake suitable for being used between a yarn preparing device and a loom, comprising a movable brake element which is movable between a position of rest on one side of the yarn and a braking position on the other side of the yarn, wherein the brake element is coupled to an electric driving motor via a shaft, **characterized in that** the acceleration of the shaft and the parts connected thereto is determined with every stroke of the brake element, and if the measured value is higher than or lower than a specified value, a signal indicating this will be generated.

2. A method according to claim 1, **characterized in that** the determination of the acceleration value takes place by establishing the distance between the position of rest and the position of the brake movement at a specific point in time as well as the maximum current or the average current that occurs during the movement between the position of rest and the position at said specific point in time, after which the quotient of the distance travelled and the maximum current is determined and a signal will be generated if a specified value is exceeded.

3. A method according to claim 2, **characterized in that** the aforesaid position at said specific point of time in the path of movement of the moving brake element lies before the position at which the brake element normally comes into contact with the yarn.

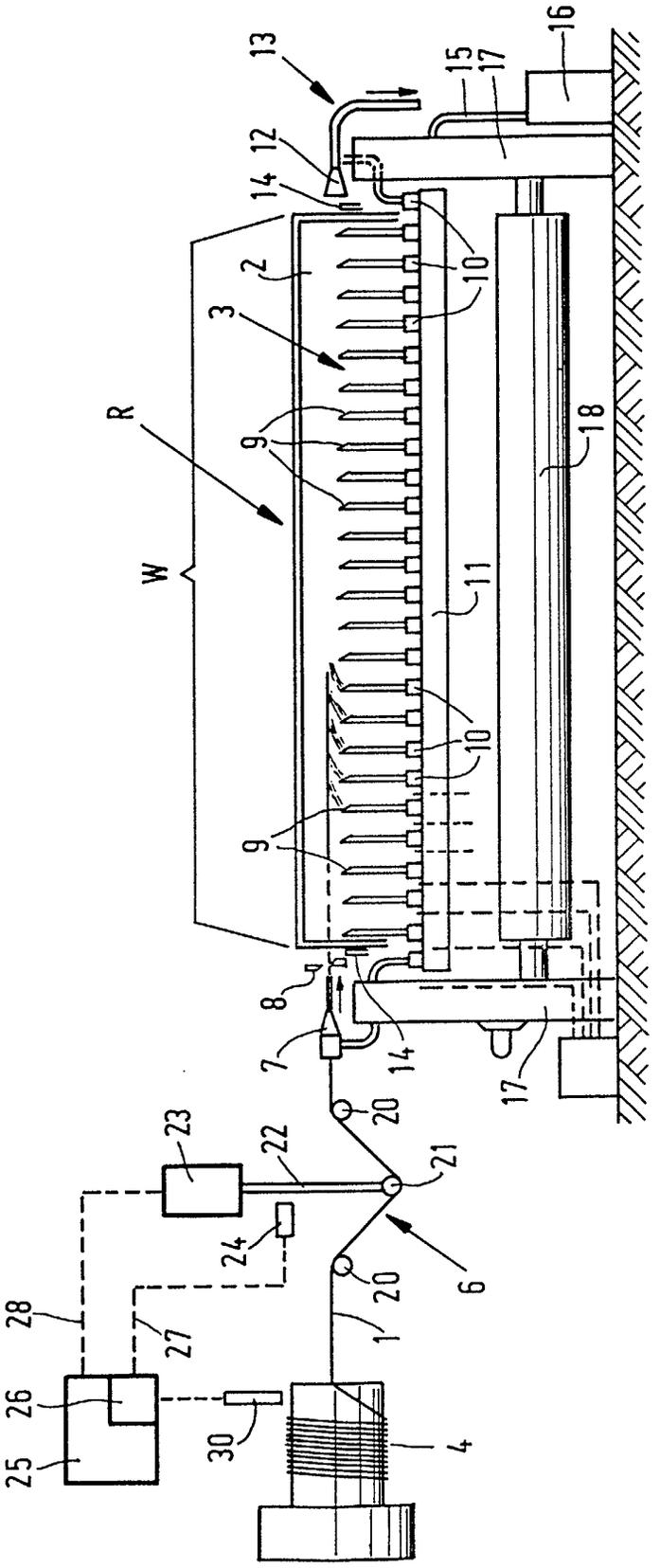
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FIG. 1

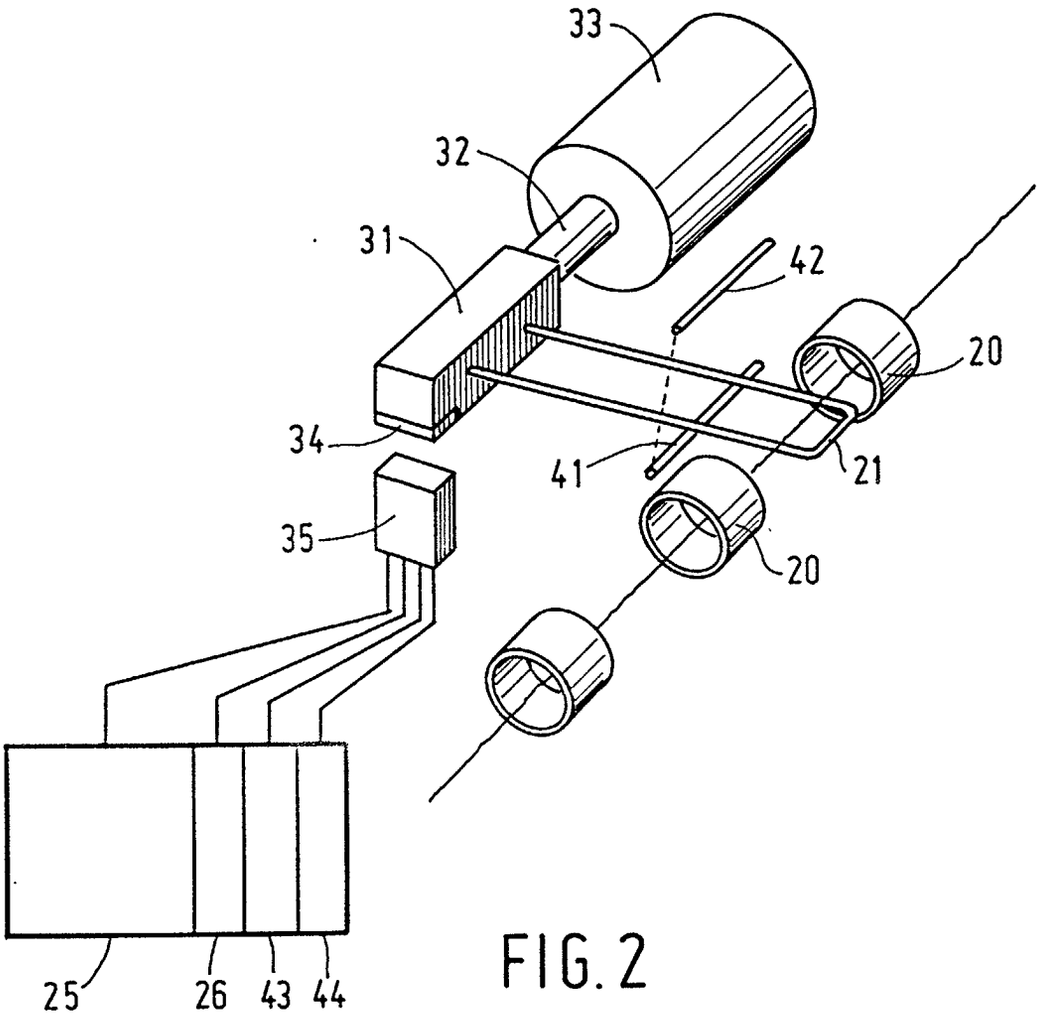

FIG. 2

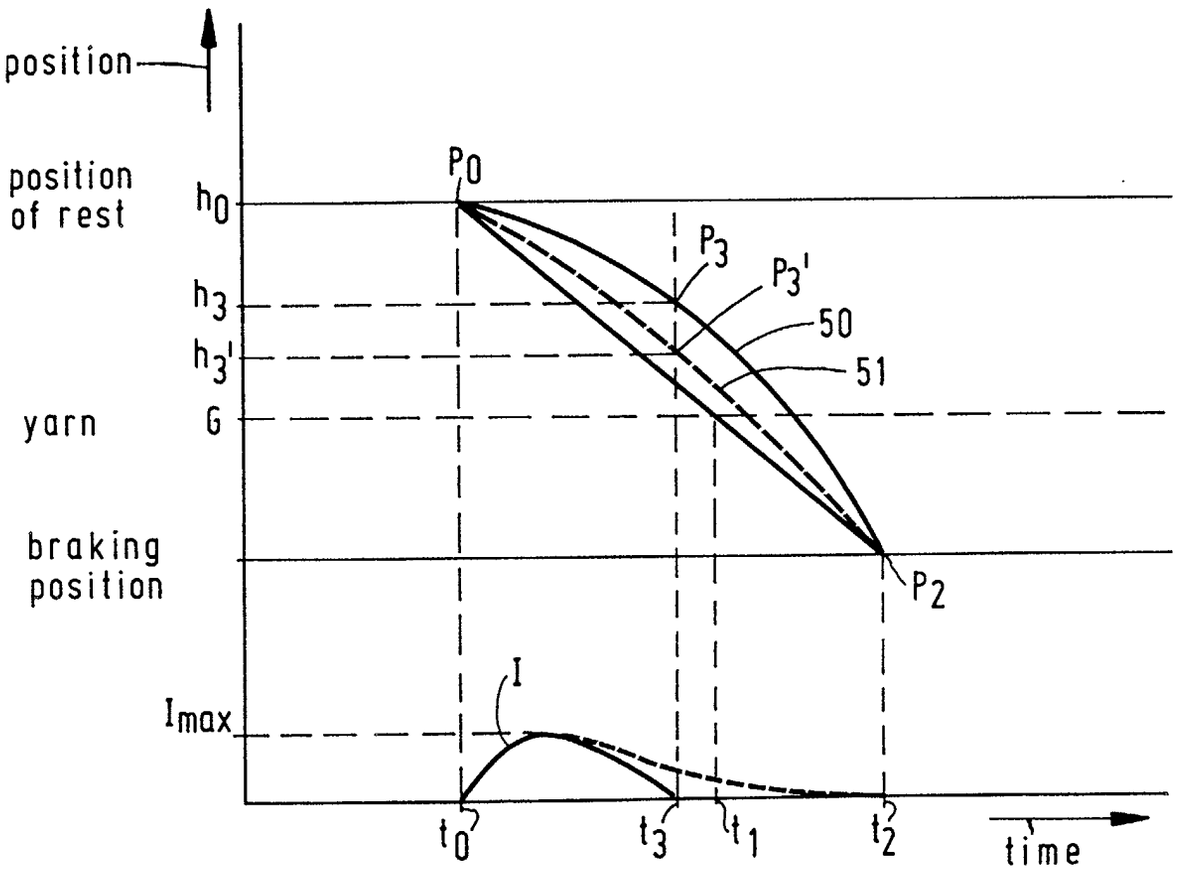
position
position of rest
h_0
h_3
h_3'
yarn
G
braking position
I_{max}
I
P_0
P_3
P_3'
50
51
P_2
t_0
t_3
t_1
t_2
time

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

D03D
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	31 May 2002	Boutelegier, C

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