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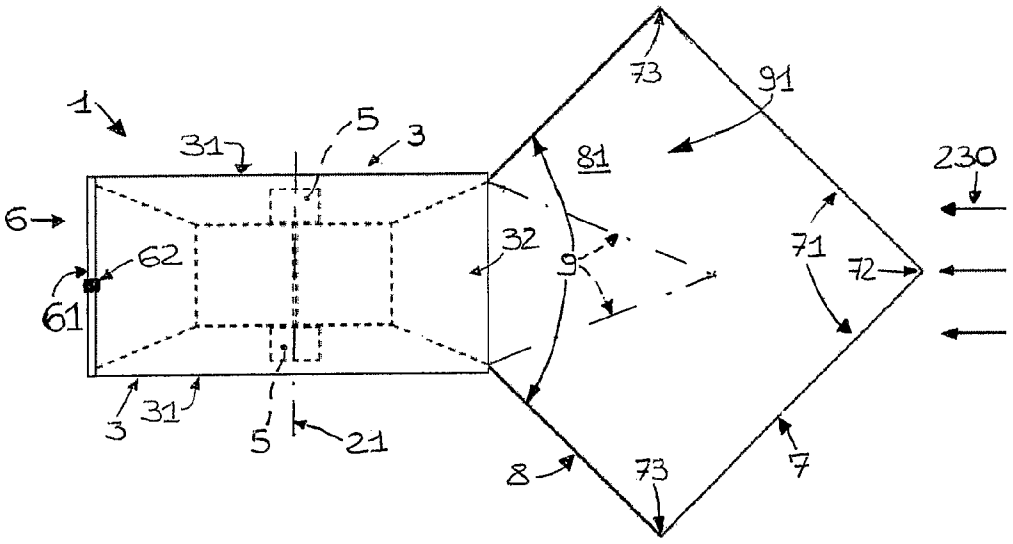
(54) Title: HYDROELECTRIC FLOATING DEVICE AND HYDROELECTRIC POWER STATION COMPRISING SUCH A DEVICE



(57) Abstract: A hydroelectric floating device comprises a rotating member comprising a plurality of vanes and at least one power generator (5) operatively connected to the rotating member. The rotating member (2) is typically associated with means (3) of buoyancy in a fluid stream (230), at least one of the vanes of the rotating member (2) being at least partly submersible in the fluid stream (230). The hydroelectric floating device (1) further comprises means for anchoring the buoyancy means (3) to a point that is substantially fixed in space. Furthermore, means (6, 61, 62) for dynamically balancing the system, means (9) for adjusting the inlet (91) to the rotating member and means (71, 72) for preventing foreign objects from damaging the rotating member (2) have been provided.

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Description

Hydroelectric floating device and hydroelectric power station comprising such a device

Technical Field

This invention relates to a hydroelectric floating device and to a hydroelectric power station comprising such a device.

The hydroelectric floating device and the hydroelectric power stations comprising the device are used for generating electricity.

Prior Art

Hydroelectric power stations normally comprise a barrier constructed to hold back a stream or river so as to form a reservoir upstream of a turbine. Water is channelled from the reservoir by a penstock. At its downstream end, the penstock leads directly to the inlet of a Francis, Pelton or Kaplan type turbine driven by the power of the water as it falls from the reservoir upstream of the turbine to the reservoir downstream of it. The turbine has a runner that is firmly fixed to the infrastructure of the power station and is operatively connected to an electrical power generator.

Hydroelectric power stations of this type have several disadvantages.

In particular, they require massive infrastructures that are not only very expensive but also have a considerable impact on the environment. In fact, the barrier construction creates an artificial lake that severely alters the geography and ecosystem of a region.

Disclosure of the Invention

It is an aim of this invention to overcome the above mentioned disadvantages by providing a hydroelectric floating device and a hydroelectric power station comprising such a device that can be used to generate power from a source that is renewable, free and does not pollute the environment.

Another aim of the invention is to provide a hydroelectric floating device and a hydroelectric power station comprising such a device that do not require fixed infrastructure which has a strong impact on the environment and which alters the geography of river systems.

These aims and others, which shall become more readily apparent in the course of the description that follows, are achieved, in accordance with the present invention, by a hydroelectric floating device having the structural and functional characteristics defined in the accompanying independent claims, other embodiments of the device being defined in the corresponding dependent claims.

Brief Description of the Drawings

The invention is described in more detail below with reference to the accompanying drawings which illustrate a preferred embodiment of it without limiting its scope.

Figures 1a to 1c are three schematic orthogonal views of a first constructional embodiment of the invention.

Figures 2a and 2b show two schematic orthogonal views, with some parts cut away in order to better illustrate others, of a constructional variant according to the invention.

Figures 2c and 2d are two front views of further constructional variants according to the invention.

Figure 3a is a schematic view of a second constructional embodiment of the invention.

Figures 3b and 3c show two schematic orthogonal views, with some parts cut away in order to better illustrate others, of a variant of the second constructional embodiment of the invention.

Figure 4 is a schematic view from above of a third constructional embodiment of the invention.

Figures 5a and 5b show two schematic orthogonal views of a fourth constructional embodiment of the invention.

Figures 6a and 6b show two schematic orthogonal views of a further constructional variant of the device according to the invention.

Figure 7 is a top view of an application of the invention.

Detailed Description of the Preferred Embodiments of the Invention

With reference to the accompanying drawings, the numeral 1 denotes a hydroelectric floating device.

The hydroelectric floating device comprises a rotating member 2 which in turn comprises a plurality of vanes 20.

The rotating member 2 advantageously comprises a central wheel 22 to which the vanes 20 are connected.

The floating device 1 further comprises at least one power generator 5 operatively connected to the rotating member 2 to convert the kinetic energy produced by the rotation of the rotating member 2 into electrical energy.

The hydroelectric floating device 1 typically comprises means 3 of buoyancy in a fluid stream 23, said buoyancy means 3 being associated with the rotating member 2. Further, at least one of the vanes 20 of the rotating member 2 is at least partly submersible in the fluid stream 23. The fluid stream 23 advantageously consists of a stream of water such as a river or a sea current. The hydroelectric floating device 1 comprises means 4 for anchoring the buoyancy means 3 to a point that is substantially fixed in space. Advantageously, the hydroelectric floating device 1 comprises means 4 for anchoring the buoyancy means 3 to a fixed point in space.

The anchoring means 4 advantageously comprise cables 41 that attach the hydroelectric floating device 1 to dry land. The cables 41 might also be electrical cables for carrying the electricity generated by the power generator 5.

The rotating member 2 advantageously comprises a rotor 200 which, during use, has a substantially horizontal axis of rotation 21 outside the fluid stream 23. The axis of rotation 21 is substantially orthogonal to the flow direction of the fluid stream 23. In the accompanying drawings, the flow direction of the fluid stream 23 is labelled 230. The vanes 20 extend at least partly in a radial direction. The rotation axis 21 coincides preferably with the axial axis of symmetry of the

wheel 22. Advantageously, the wheel 22 comprises an outer circumferential surface 220 from which the vanes 20 extend radially.

Alternatively, as illustrated in Figures 2a, 2b, 2c, 2d, the rotating member 2 comprises a track 201. The track 201 comprises an endless belt 202 and at least two peripheral rollers 203; the endless belt 202 is trained around the at least two rollers 203. The power generator 5 is advantageously connected to one or more rollers 203 and is driven by the latter. The belt 202 comprises an inside surface 204 that faces the rollers 203 and an outside surface 205 on the side opposite the inside surface 204; the vanes 20 are advantageously attached to the outside surface 205.

The vanes 20 are mobile between a first, rest position in which the vanes 20 are substantially parallel with the belt 202 and a second, working position where the vanes 20 are substantially transversal to the belt 202. The track 201 comprises hinges for connecting the belt 202 to the vanes 20. The track 201 also comprises abutting elements 206 located at the vanes 20 which abut against the vanes 20 in the second, working position. Advantageously, the abutting elements 206 are integral with the vanes 20. The rollers 203 have a substantially horizontal rotation axis 21. The rollers 203 preferably, but not necessarily, define an upper portion and a lower portion of the belt 202. The vanes 20 in the upper portion are in the first, rest position while those in the lower portion are in the second, working position. In the second, working position, the vanes 20 intercept the fluid stream 23. In the first, rest position, on the other hand, the vanes 20 are advantageously parallel to the belt 202 so as not to create wind resistance. This embodiment is particularly advantageous in that there are more vanes 20 submerged in the fluid stream 23 and which actively participate in transferring energy to the rotating member 2. Also, where the vanes 20 cannot intercept the entire fluid stream 23, the rotating member 2, thanks to the viscosity of the water, captures part of the kinetic energy of the fluid stream 23 flowing under the vanes 20.

In a first constructional embodiment, the buoyancy means 3 comprise two floats 31. The two floats 31 support the rotating member 2 through suitable supports. The rotating member 2 is preferably positioned between the two floats 31. The two floats 31 define a flow channel 32 for conveying the fluid stream 23 into the hydroelectric floating device 1. Advantageously, but without limiting the invention, the hydroelectric floating device 1 comprises a bottom wall 321 delimiting the flow channel 32. The rotating member 2 is preferably located in the space defined by the flow channel 32. The vanes 20 of the rotating member 2 intercept the fluid stream 23 that flows into the flow channel 32.

Optionally, the hydroelectric floating device 1 comprises means 6 for dynamically balancing the hydroelectric floating device 1. The dynamic balancing means 6 are used to shift the dynamic centre of gravity of the hydroelectric floating device 1 as it rocks with the wave motion created by the fluid stream 23. The dynamic balancing means 6 stabilise the hydroelectric floating device 1 in a direction orthogonal to the flow direction of the fluid stream 23. Advantageously, dynamic balancing means 6 are also provided to act in a direction parallel to the flow direction of the fluid stream 23. In this way, the hydroelectric floating device 1 is substantially stabilised.

The dynamic balancing means 6 comprise a worm screw 61 and a system for moving a ballast 62 along the worm screw 61.

The balancing means 6 comprise horizontality sensors operatively connected to the ballast 62 moving system. The horizontality sensors may, for example, comprise a level.

The hydroelectric floating device 1 advantageously comprises a protective grill 7 positioned upstream of the rotating member 2 relative to the flow direction 230 of the fluid stream 23. The grill 7 is designed to prevent foreign objects from striking or damaging the rotating member 2 or interfering with its movement. The grill 7 also protects the fauna that inhabits the fluid stream 23.

The hydroelectric floating device 1 optionally comprises a

conveyor 8 located upstream of the rotating member 2 relative to the flow direction 230 of the fluid stream 23. The conveyor 8 intercepts a certain quantity of flowing water and directs it to the rotating member 2 in order to drive the latter.

The conveyor 8 is located upstream of the flow channel 32 relative to the flow direction 230 of the fluid stream 23 and controls the speed of the fluid stream 23 in the flow channel 32 itself.

As illustrated in Figures 1a to 1c the conveyor 8 is advantageously variable in shape. The continuous line in Figure 1b shows the conveyor 8 in a fully open configuration, whilst the dot-dashed line shows the conveyor 8 in a closed configuration. The variable shape conveyor 8 makes it possible to control the flow processed by the rotating member 2 in accordance with the speed of the fluid stream 23 upstream of the device 1. On the one hand, this keeps the rotating member 2 turning at a constant rate thereby keeping the frequency of the power generator 5 constant and, on the other hand, enables the device 1 to operate even when a river floods. During a flood, the undisturbed speed of the fluid stream 23 increases considerably and, to avoid excessive stress to the electrical equipment connected to the device 1, the flow processed by the rotating member 2 must be reduced. The conveyor 8 comprises two adjustable arms 9 defining an inlet 91. The two adjustable arms 9 can be turned in a substantially horizontal plane. The bottom of the conveyor 8 is preferably delimited by a fixed plate 81.

Advantageously, the hydroelectric floating device 1 comprises actuators for turning the adjustable arms 9. The actuators are controlled by speed sensors that measure the speed of the fluid stream 23 upstream of the rotating member 2. Advantageously, these speed sensors measure the speed of the fluid in the flow channel 32. The conveyor 8 accordingly regulates the water flow to the rotating member 2. As a result, the power generator 5 connected to the rotating member 2 turns at a constant speed.

For this reason, the power generator 5 is advantageously of asynchronous type connectable in parallel with a power grid.

This connection is accomplished through suitable electrical components located in a power processing unit 12. As illustrated in Figures 1a to 1c, the grill 7 is located upstream of the conveyor 8 relative to the flow direction 230 of the fluid stream 23. The grill 7 consists of two portions 71 hinged to each other along a first, shared vertical edge 72. The other second vertical edge 73 of each portion of the grill 7 is connected by hinges directly to the respective arm 9 of the conveyor 8.

In a second constructional embodiment, the hydroelectric floating device 1 comprises means 10 for controlling the waterline of the hydroelectric floating device 1 itself. These means 10 for controlling the waterline of the hydroelectric floating device 1 might be provided as auxiliary means in the first constructional embodiment, too. The means 10 for controlling the waterline comprise flaps 101 that are at least partly submersible in the fluid stream 23. Each flap 101 consists of at least one protrusion of the hydroelectric floating device 1.

The flaps 101 are adjustable with respect to the hydroelectric floating device 1. The flaps 101 can turn about a substantially horizontal axis 102.

In a first configuration, the flaps 101 are positioned outside the fluid stream 23. During use, they can be submerged in the fluid stream 23. When the flaps 101 are submerged, the fluid stream 23 pushes them upwards in such a way as to lift the hydroelectric floating device 1 which the flaps 101 are connected to. As a result of this upward pushing force, the hydroelectric floating device 1 is lifted with respect to the surface of the water, thus reducing the water flow intercepted by the vanes 20. In the constructional embodiments illustrated in Figures 3a to 3c, the flaps 101 are mounted at the front of the device 1. The front is the part that first intercepts the flow of the fluid stream 23. The front of the device 1 is thus lifted and the amount of water flowing into the inlet of the flow channel 32 reduced. In this second constructional embodiment, the power generator 5 does not turn at a perfectly

constant speed.

Advantageously, in this second embodiment, the power generator 5 is preferably of the synchronous type with permanent magnets. In the power processing unit 12, the variable frequency three-phase electrical current generated is rectified and re-transformed by an inverter into a three-phase 50 Hz alternating current and fed into the power grid. In the second constructional embodiment, too, the hydroelectric floating device 1 comprises the bottom wall 321 delimiting the flow channel 32. In the hydroelectric floating device 1 illustrated in Figure 3a, which is suitable for rivers of a torrential nature, the wall 321 is substantially horizontal. In a variant (illustrated in Figure 3b) of this constructional embodiment, the wall 321 is inclined to the horizontal; in a substantially vertical section parallel with the flow direction of the fluid stream 23, the flow channel 32 is convergent. The variant illustrated in Figure 3b is preferable for deep rivers. A top wall, on the other hand, delimits the flow channel 32 in both the floating device 1 illustrated in Figure 3a and in the one illustrated in Figure 3b.

In a third constructional embodiment illustrated in Figure 4, the conveyor 8 has a fixed shape. In this third embodiment, the conveyor 8, which suitably accelerates the fluid stream 23, is located upstream of the flow channel 32 relative to the flow direction 230 of the fluid stream 23. Advantageously, the hydroelectric floating device 1 is preferably the same as the one described for the second constructional embodiment illustrated in Figures 3a to 3c. The conveyor 8 advantageously comprises two arms 9. The bottom of the conveyor 8 is defined by the fixed plate 81. The protective grill 7 is mounted at the front of it. The conveyor 8 is advantageously attached to the hydroelectric floating device 1. In another variant which is not illustrated, the conveyor 8 is not connected to the hydroelectric floating device 1 but is simply positioned upstream of it relative to the flow direction 230 of the fluid stream 23. The outlet section of the conveyor 8 is preferably equal in width to the hydroelectric floating device 1, including

the flaps 101. The third constructional embodiment is advantageously used in slow flowing rivers (with water speed of 1 m/s for example). It is characterised by extreme constructional simplicity.

In a fourth constructional embodiment, the rotating member 2 includes a hollow internal compartment 33, said hollow internal compartment 33 constituting the buoyancy means 3. The rotating member 2 is connected to the power generator 5 by transmission means 52. The power generator 5 is mounted on a floating cushion 51. The cushion 51 prevents the power generator 5 from going under the surface of the fluid stream 23 (usually water) as a result of the rocking movements of the hydroelectric floating device 1. Advantageously, one end of the anchoring means 4 is forked and is connected to two ends of the shaft which the rotating member 2 is keyed to. This shaft can rotate about the anchoring means 4. In the non-limiting example embodiment illustrated in Figures 5a and 5b, the power generator 5 is attached to both the rotating member 2 and to the anchoring means 4. Advantageously, the hydroelectric floating device 1 comprises balancing means 6.

In the constructional variant illustrated in Figures 6a and 6b, the power generator 5 is operatively connected to two rotating members 2; each rotating member 2 is connected by transmission means 52 to the same shaft of the power generator 5. These transmission means 52 advantageously comprise a belt that connects two sheaves, one integral with the rotating member 2 and the other integral with the shaft of the power generator 5. This variant may advantageously be applied to all the constructional embodiments described above.

With reference to all the constructional embodiments described, the hydroelectric floating device 1 may comprise a drive multiplier operatively interposed between the rotating member 2 and the power generator 5. Consequently, the number of poles of the power generator 5 must be selected accordingly.

The reference numeral 100 in Figure 7 denotes a power station. The power station 100 comprises at least one hydroelectric floating device 1 of the type described above.

The power station 100 advantageously comprises at least one power processing unit 12 to collect the power produced by the hydroelectric floating device 1 and to make it suitable to be fed into the power grid. The power processing unit 12 is operatively connected to the hydroelectric floating device 1 at least by electrical cables.

The power station 100 may comprise a series of hydroelectric floating devices 1 located along or across the river and held in place by the anchoring means 4. The power station 100 may also comprise a series of hydroelectric floating devices 1 located across the river and constituting a pontoon bridge.

In Figure 7 the anchoring means 4 comprise a support that spans a river. The support is attached to two trestles 42 located on the two banks of the river. The anchoring means 4 comprise one or more cables 41 connecting a plurality of hydroelectric floating devices 1 to the support.

The present invention brings important advantages.

First of all, it has a very low environmental impact and does not in any way alter the geography of the river system.

Secondly, it allows power to be generated with practically no restrictions along the full course of a river, stream, canal or sea current.

The invention described may be modified and adapted in several ways without thereby departing from the spirit of the inventive concept that characterises it.

Moreover, all the details of the invention may be substituted by technically equivalent elements.

In practice, the embodiments of the invention may be made from any material, and in any size, depending on requirements.

Claims

1. A hydroelectric floating device of the type comprising:
- a rotating member (2) comprising a plurality of vanes (20);
- at least one power generator (5) operatively connected to the rotating member (2) to convert the kinetic energy produced by the rotation of the rotating member (2) into electrical energy;
the hydroelectric floating device (1) being characterised in that it comprises:
- means (3) of buoyancy in a fluid stream (23), said buoyancy means (3) being associated with the rotating member (2) and at least one of the vanes (20) of the rotating member (2) being at least partly submersible in the fluid stream (23);
- means (4) for anchoring the buoyancy means (3) to a point that is substantially fixed in space.

2. The hydroelectric floating device according to claim 1, characterised in that the rotating member (2) comprises a rotor (200) which, during use, rotates about a substantially horizontal rotation axis (21) outside the fluid stream (23).

3. The hydroelectric floating device according to claim 1, characterised in that the rotating member (2) comprises a track (201).

4. The hydroelectric floating device according to claim 3, characterised in that the track (201) comprises an endless belt (202) and at least two peripheral rollers (203), the endless belt (202) being trained around the two rollers (203).

5. The hydroelectric floating device according to claim 4, characterised in that the belt (202) comprises an inside surface (204) that faces the rollers (203) and an outside surface (205) on the side opposite the inside surface (204), the vanes (20) being attached to the outside surface (205).

6. The hydroelectric floating device according to claim 4 or 5, characterised in that the vanes (20) are mobile between a first, rest position in which the vanes (20) are substantially parallel with the belt (202) and a second, working position where the vanes (20) are substantially transversal to the belt (202).

7 The hydroelectric floating device according to claim 6, characterised in that the track (201) comprises:
- hinges for connecting the belt (202) to the vanes (20);
- abutting elements (206) located at the vanes (20) which abut against the vanes (20) in the second, working position.

8. The hydroelectric floating device according to any of the foregoing claims, characterised in that the buoyancy means (3) comprise two floats (31).

9. The hydroelectric floating device according to claim 8, characterised in that the rotating member (2) is positioned between the two floats (31), said two floats (31) forming a flow channel (32) for conveying the fluid stream (23) into the hydroelectric floating device (1).

10. The hydroelectric floating device according to any of the foregoing claims, characterised in that it comprises means (6) for dynamically balancing the hydroelectric floating device (1).

11. The hydroelectric floating device according to claim 10, characterised in that the balancing means (6) comprise a worm screw (61) and a system for moving a ballast (62) along the worm screw (61).

12. The hydroelectric floating device according to claim 11, characterised in that the balancing means (6) comprise horizontality sensors operatively connected to the ballast (62) moving system.

13. The hydroelectric floating device according to any of the foregoing claims, characterised in that it comprises a protective grill (7) located upstream of the rotating member (2) relative to the flow direction (230) of the fluid stream (23).

14. The hydroelectric floating device according to any of the foregoing claims, characterised in that it comprises a conveyor (8) located upstream of the rotating member (2) relative to the flow direction (230) of the fluid stream (23).

15. The hydroelectric floating device according to claim 14 when dependent on claim 9, characterised in that the conveyor (8) is positioned upstream of the flow channel (32) relative to the flow direction (230) of the fluid stream (23), to control the speed of the fluid stream (23) in the flow channel (32) itself.

16. The hydroelectric floating device according to claim 14 or 15, characterised in that the conveyor (8) has a fixed shape.

17. The hydroelectric floating device according to claim 14 or 15, characterised in that the conveyor (8) has a variable shape.

18. The hydroelectric floating device according to claim 17, characterised in that the conveyor (8) comprises two adjustable arms (9) that form an inlet (91).

19. The hydroelectric floating device according to claim 18, characterised in that it comprises actuators for turning the adjustable arms (9), said actuators being controlled by speed sensors that measure the speed of the fluid stream (23) upstream of the rotating member (2).

20. The hydroelectric floating device according to claim 17 or 18 or 19, characterised in that the power generator (5) is of asynchronous type connectable in parallel with a power grid.

21. The hydroelectric floating device according to any of the foregoing claims from 1 to 19, characterised in that it comprises means (10) for controlling the waterline of the hydroelectric floating device (1).

22. The hydroelectric floating device according to claim 21, characterised in that the means (10) for controlling the waterline comprise flaps (101) which are at least partly submersible in the fluid stream (23).

23. The hydroelectric floating device according to claim 22, characterised in that the flaps (101) are adjustable with respect to the hydroelectric floating device (1), said flaps (101) being rotatable about a substantially horizontal axis (102).

24. The hydroelectric floating device according to claim 21 or 22 or 23, characterised in that the power generator (5) is of synchronous type with permanent magnets.

25. The hydroelectric floating device according to any of the foregoing claims, characterised in that it comprises a drive multiplier operatively interposed between the rotating member (2) and the power generator (5).

26. The hydroelectric floating device according to any of the foregoing claims, characterised in that the rotating member (2) comprises a hollow internal compartment (33), said hollow internal compartment (33) constituting the buoyancy means (3).

27. A power station characterised in that it comprises at least one hydroelectric floating device (1) according to any of the claims from 1 to 26.

28. The power station according to claim 27, characterised in that it comprises at least one power processing unit (12) for

collecting the power produced by the hydroelectric floating devices (1) and to make it suitable to be fed into a power grid.

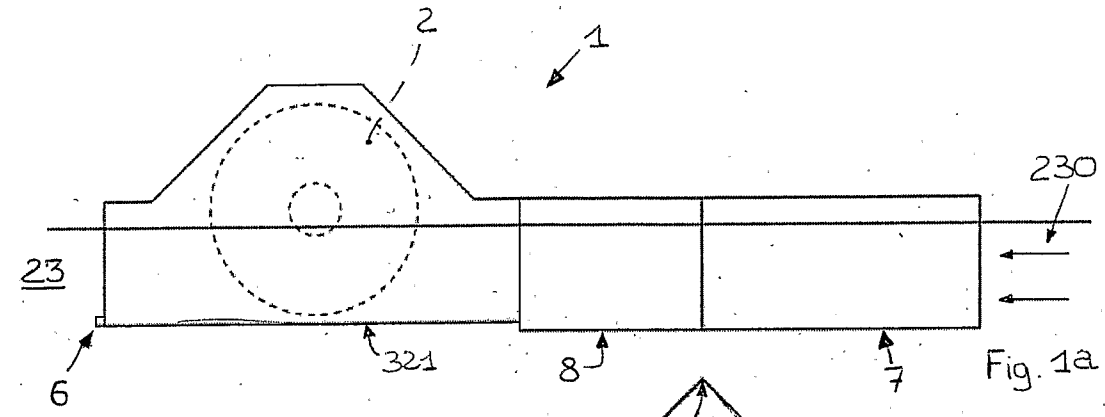

Fig. 1a

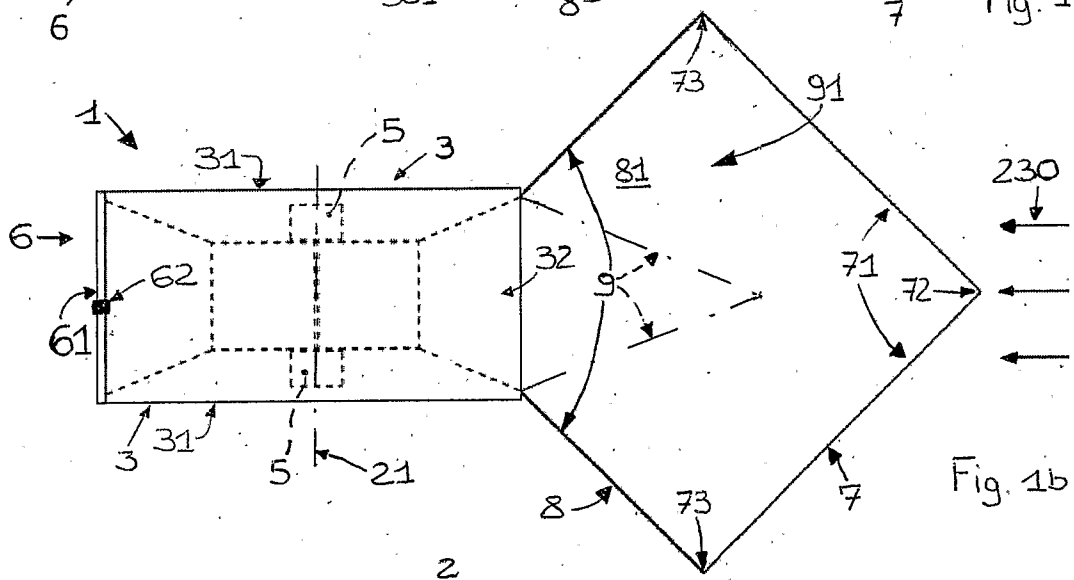

Fig. 1b

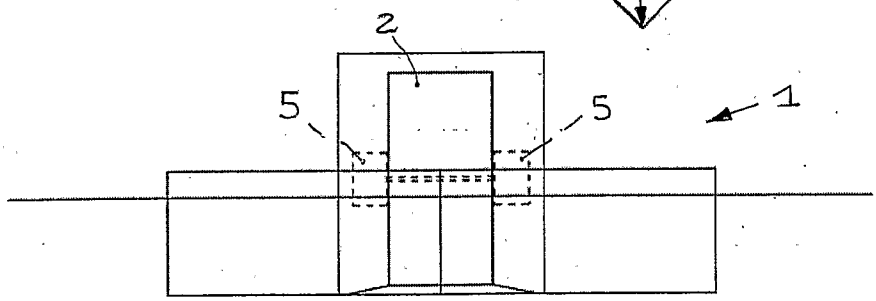

Fig. 1c

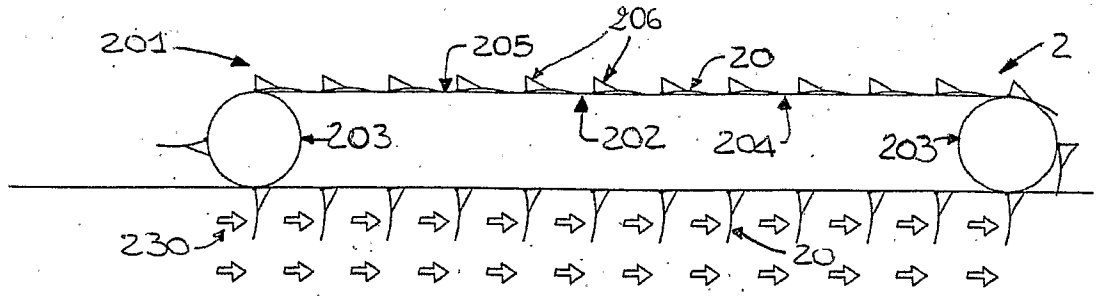

Fig.2a

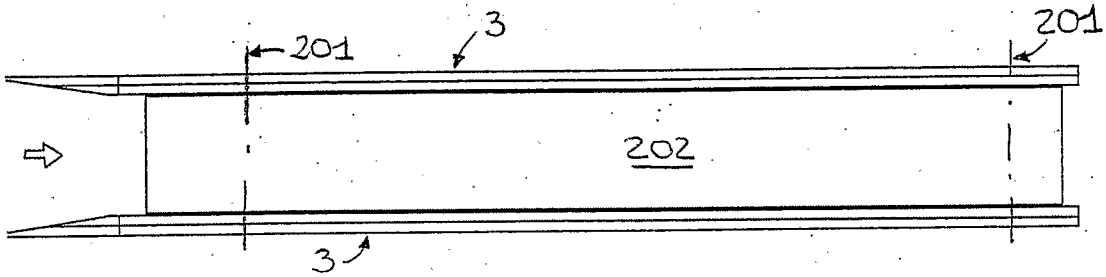

Fig.2b

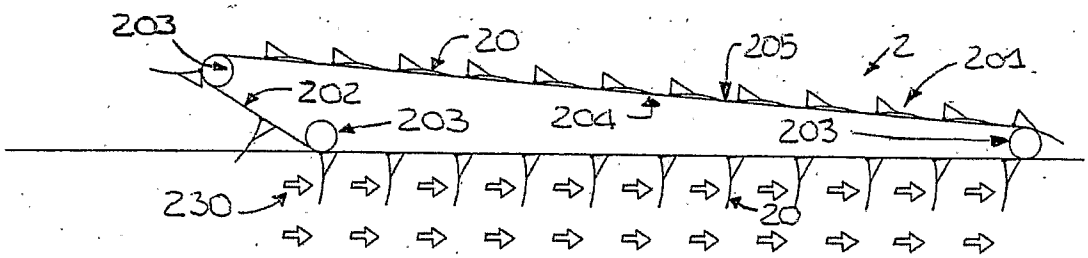

Fig.2c

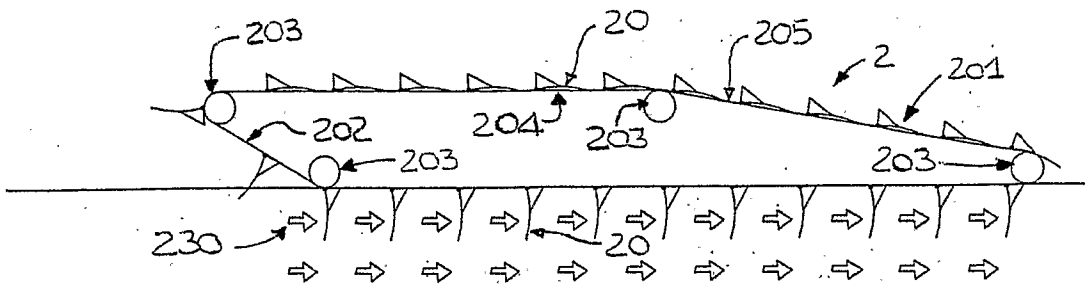

Fig.2d

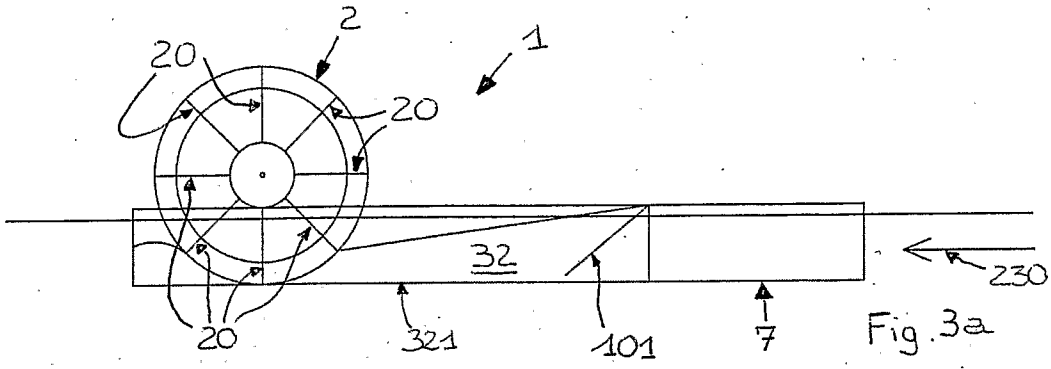

Fig.3a

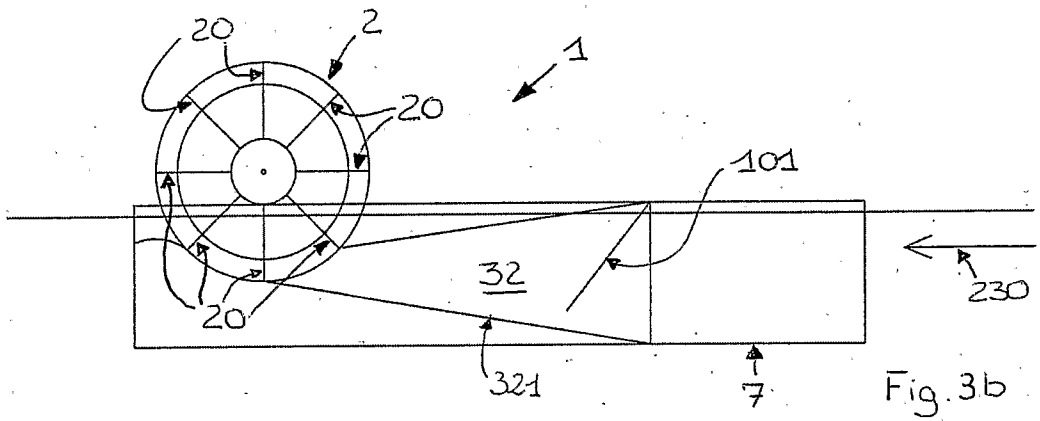

Fig.3b

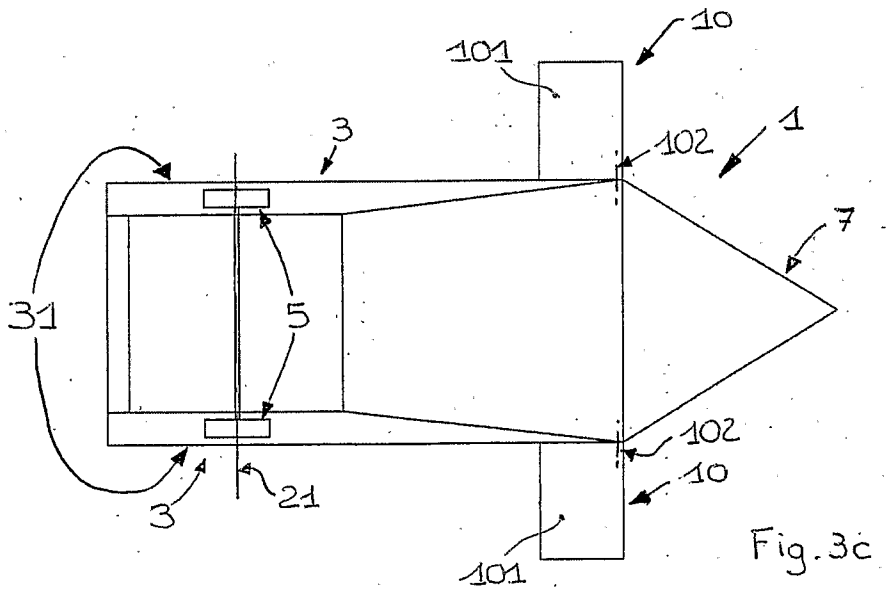

Fig.3c

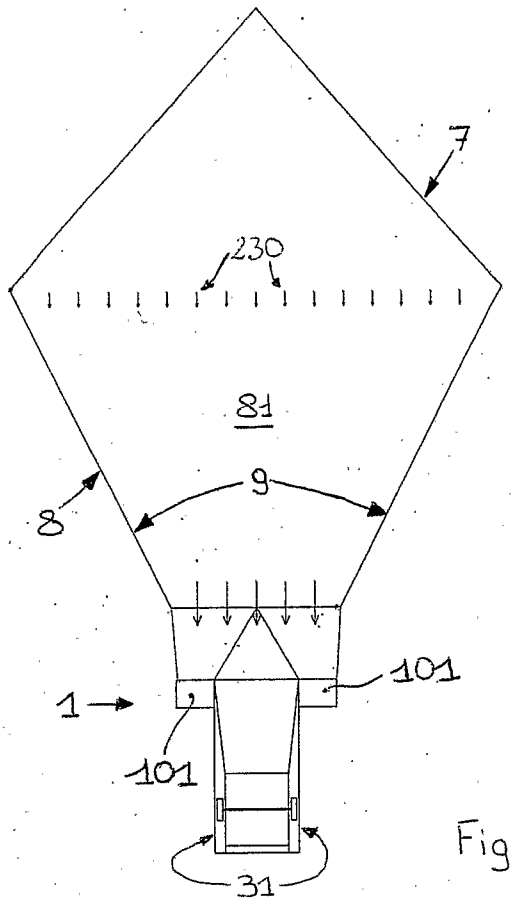

Fig. 4

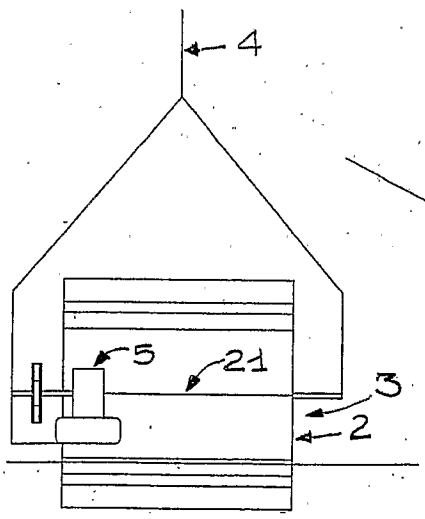

Fig.5a

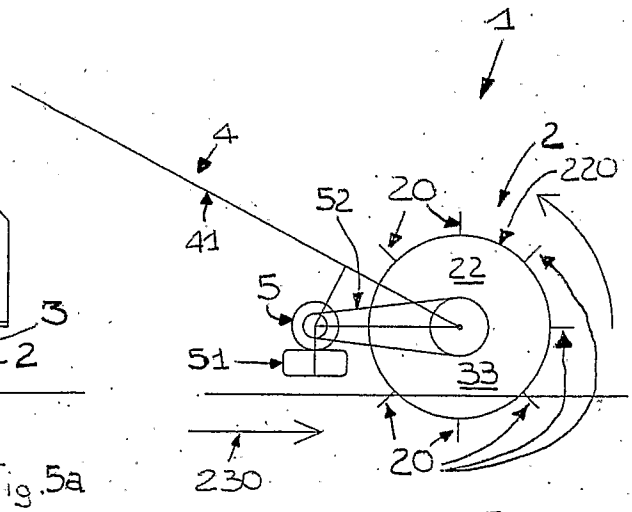

Fig. 5b

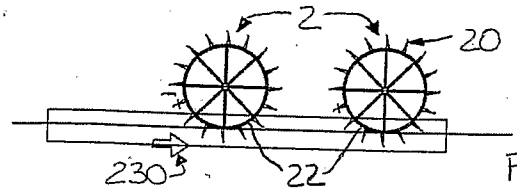

Fig.6a

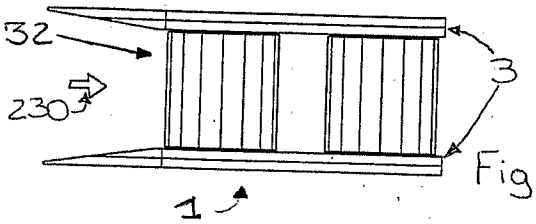

Fig.6b

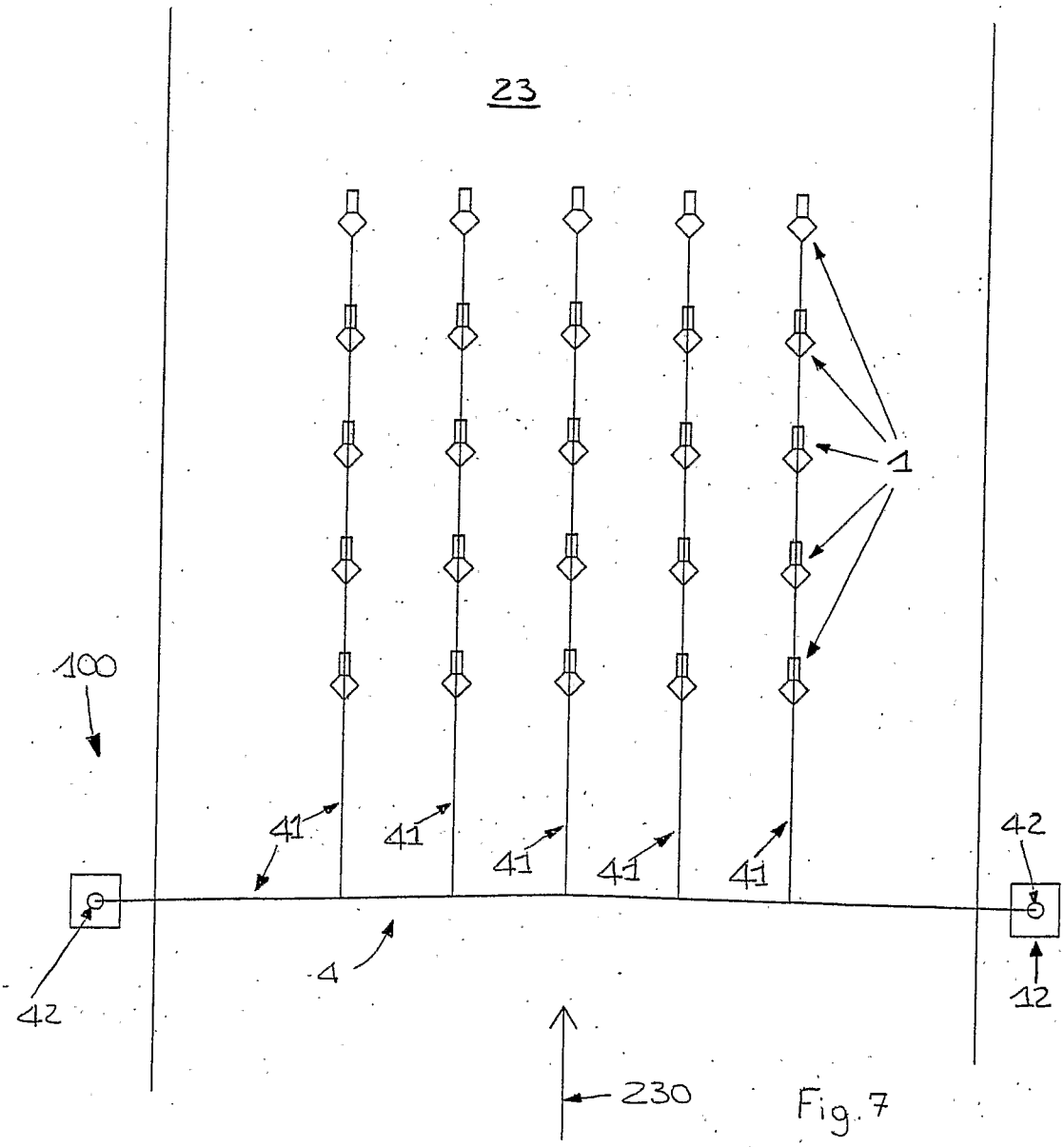

Fig.7

INTERNATIONAL SEARCH REPORT

ional application No
PCT/IT2005/000749

A. CLASSIFICATION OF SUBJECT MATTER
INV. F03B17/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 1 175 566 A (LOUIS-GEORGES OMBREDANE) 27 March 1959 (1959-03-27) the whole document	1-6,8,9, 13,14, 21,22, 25,27
X	FR 891 732 A (CLÉMENT SAQUET) 17 March 1944 (1944-03-17) page 1, line 26 - page 2, line 22; figures	1,2,8,9, 13-16,27
X	DE 70 833 C (H. VON SAMSON-HIMMELSTJERNA) 13 January 1893 (1893-01-13) the whole document	1,2,8,9, 14,15, 17,18, 21-23,27

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
3 August 2006	14/08/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	de Rooij, M

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 008, no. 094 (M-293), 28 April 1984 (1984-04-28) -& JP 59 007783 A (RIYOUICHI FUJIWARA), 14 January 1984 (1984-01-14) abstract; figures	1,3-9,27
X	US 313 746 A (ALBON MAN) 10 March 1885 (1885-03-10) page 1, line 87 - page 2, line 2; claims 5-10; figures 1-3	1,2,8,9, 15,17, 18,21,27
X	GB 701 716 A (CHALERM SAKUNWADHNA) 30 December 1953 (1953-12-30) page 1, line 64 - page 2, line 2 page 2, line 61 - page 3, line 6; figures	1,2, 8-10, 14-16, 21,26
X	US 4 737 070 A (HORIUCHI ET AL) 12 April 1988 (1988-04-12) page 7, line 57 - page 8, line 21; figures 1,2,12-15,20-22 column 10, line 14 - line 43 column 11, line 59 - column 12, line 42 column 13, line 36 - column 14, line 11 column 15, line 48 - line 66	1,2,10, 21-23,26

INTERNATIONAL SEARCH REPORT

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I onal application No
PCT/IT2005/000749

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