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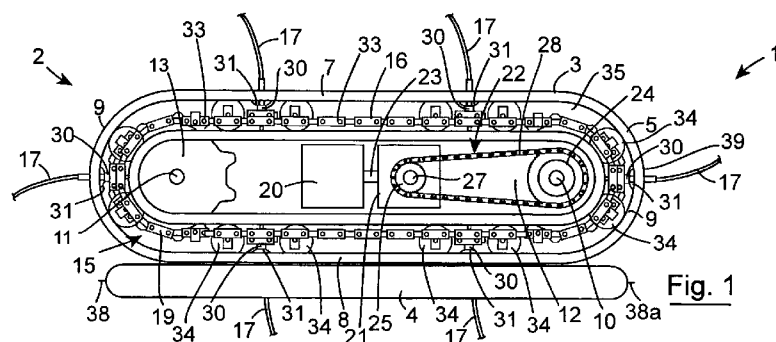
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(54) Title: AN ENERGY CONVERTER AND A METHOD FOR CONVERTING KINETIC ENERGY IN A STREAM OF FLOWING WATER TO ROTATIONAL ENERGY, AND A HYDROELECTRICITY GENERATOR



(57) Abstract: An hydroelectricity generator (1) comprises a chassis (3) supported on a pair of floats (4). A pair of primary transmission chains (16) are carried on first and second primary sprockets (12) and (13) which are mounted fast on an output shaft (10) and an idler shaft (11), respectively, which in turn are rotatably carried in side frames (5) of the chassis (3). Water engaging paddles (17) carried on the primary transmission chains (16) at spaced apart intervals along the primary transmission chains (16) extend downwardly from lower legs (19) of the primary chains (16) to extend into a stream of flowing water. Water flowing in the direction of the arrow A impinging on the water engaging paddles (17) urges the water engaging paddles (17) in the direction of the arrow A for in turn urging the lower legs (19) of the primary transmission chains (16) also in the direction of the arrow A for rotating the output shaft (10) in order to convert linear motion of the water engaging paddles (17) into rotational energy of the output shaft (10). An electricity generator (20) mounted on the chassis (3) is driven from the output shaft (10) through a secondary chain and sprocket transmission (22) and a gearbox (21) for generating electricity.

“An energy converter and a method for converting kinetic energy
in a stream of flowing water to rotational energy, and a hydroelectricity generator”

The present invention relates to an energy converter and a method for converting
5 kinetic energy in a stream of flowing water to rotational energy, and the invention
also relates to a hydroelectricity generator.

Hydroelectricity generators are known. In particular, such hydroelectricity generators
are known for generating electricity from the kinetic energy of a stream of flowing
10 water, for example, flowing water in a river, flowing water as a result of tidal
movements in the ocean and the like. Such hydroelectricity generators which are
suitable for generating electricity from a river, in general, require the river to be
dammed in order to provide a head of water for the generator. Damming of a river in
the majority of instances is ecologically undesirable, and in general, is a relatively
15 expensive procedure. Additionally, hydroelectricity generators for generating
electricity from the kinetic energy of a stream of flowing water in a river or in the
ocean as a result of tidal movement tend to be relatively complex and costly, and
many tend to be relatively inefficient. In general, such hydroelectricity generators
tend to be maintenance intensive and require regular maintenance and servicing
20 which can be relatively costly. Furthermore, many such known hydroelectricity
generators are unsuitable for use in relatively small rivers, and in applications where
the velocity of the water flow in the river or tidal movement tends to be relatively low.

There is therefore a need for a hydroelectricity generator which addresses at least
25 some of these problems and disadvantages of hydroelectricity generators known
heretofore.

The present invention is directed towards providing a hydroelectricity generator
which addresses at least some of the above discussed problems and disadvantages
30 of known hydroelectricity generators. The invention is also directed towards a
method and an energy converter for converting kinetic energy in a stream of flowing
water to rotational energy, which addresses at least some of the above mentioned
problems and disadvantages of known hydroelectricity generators

According to the invention there is provided an energy converter for converting kinetic energy in a stream of flowing water to rotational energy, the energy converter comprising a chassis, a converting means adapted for converting linear motion into rotational motion, the converting means being mounted on the chassis and comprising a linearly moveable element and a rotatably mounted output shaft, the linearly moveable element co-operating with the output shaft for rotating the output shaft for producing the rotational motion from the linear motion, at least one water engaging element coupled to the linearly moveable element and adapted to extend into the stream of flowing water and being responsive to water flow therein for imparting linear motion to the linearly moveable element, and a mounting means adapted for maintaining the chassis relative to the stream of flowing water with the at least one water engaging element extending into the stream of flowing water.

Preferably, the mounting means is adapted for maintaining the chassis relative to the stream of flowing water with the at least one water engaging element extending transversely of the direction of flow of the stream of flowing water.

In one embodiment of the invention the linearly moveable element comprises at least one endless primary transmission element carried on and extending around corresponding spaced apart rotatably mounted first and second primary carrier elements. Preferably, each first primary carrier element is mounted fast on the output shaft. Advantageously, each second primary carrier element is mounted fast on a rotatably mounted idler shaft spaced apart from and extending parallel to the output shaft.

In another embodiment of the invention a pair of spaced apart primary transmission elements are provided, each primary transmission element being carried on a corresponding pair of first and second primary carrier elements. Preferably, each primary transmission element comprises a primary transmission chain, and the first and second primary carrier elements comprise respective first and second primary sprockets.

In an alternative embodiment of the invention each primary transmission element comprises a primary transmission belt, and the first and second primary carrier elements comprise respective first and second primary transmission pulleys. Preferably, each primary transmission belt comprises a primary transmission rope.
5 Advantageously, each primary transmission rope comprises a steel transmission rope.

In another embodiment of the invention a secondary transmission means is provided for transmitting the rotational motion from the output shaft to one of an hydraulic
10 pump, a pneumatic pump and an electricity generator.

In one embodiment of the invention an hydraulic pump is mounted on the chassis and is driven by the secondary transmission means. Preferably, the hydraulic pump is adapted for driving an hydraulic motor. Advantageously, the hydraulic motor is
15 adapted for mounting remote of the energy converter. Ideally, the hydraulic motor is adapted for land mounting. Preferably, the hydraulic motor is adapted for coupling to an electricity generator for generating electricity.

In an alternative embodiment of the invention a pneumatic pump is mounted on the
20 chassis and is driven by the secondary transmission means. Preferably, the pneumatic pump is adapted for coupling to a pneumatic motor. Advantageously, the pneumatic motor is adapted for mounting remote of the energy converter. Ideally, the pneumatic motor is adapted for land mounting. Preferably, the pneumatic motor is adapted for coupling to an electricity generator for producing electricity.

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In another embodiment of the invention an electricity generator is mounted on the chassis and is driven by the secondary transmission means.

In a further embodiment of the invention the secondary transmission means
30 comprises a gearbox. Preferably, the one of the hydraulic pump, the pneumatic pump and the electricity generator is driven through the gearbox.

In another embodiment of the invention the secondary transmission means

comprises a secondary transmission element carried on and extending around first and second secondary carrier elements, the first secondary transmission elements being mounted fast on the output shaft, and the second secondary carrier element being mounted fast on an input shaft of the gearbox or an input shaft of one of the hydraulic pump, the pneumatic pump and the electricity generator. Preferably, the secondary transmission element comprises a secondary transmission chain, and the first and second secondary carrier elements comprise first and second secondary sprockets, respectively.

10 In one embodiment of the invention a plurality of water engaging elements are coupled to the linearly moveable element spaced apart longitudinally along the linearly moveable element.

Preferably, each water engaging element extends transversely of each primary transmission element. Advantageously, each water engaging element comprises a water engaging paddle. Ideally, each water engaging paddle is of arcuate shape.

In one embodiment of the invention each water engaging paddle is concave when viewed from the direction of water flow in the stream of flowing water. Preferably, each water engaging element is pivotally coupled to the linearly moveable element. Preferably, an adjustment means is provided for selectively adjusting the angle of attack of each water engaging element relative to the linearly moveable element.

In another embodiment of the invention a stabilising means is provided for stabilising the linearly moveable element adjacent each water engaging element. Preferably, each stabilising means comprises at least one stabilising roller adjacent the linearly moveable element engageable with a track extending parallel to the linearly moveable element. Preferably, a pair of spaced apart guide tracks are provided on respective opposite sides of the linearly moveable element for engaging respective opposite ends of each stabilising roller. Preferably, each stabilising roller extends outwardly at respective opposite side edges of the water engaging element for engaging an adjacent one of the guide tracks.

In one embodiment of the invention a pair of stabilising rollers are provided adjacent each water engaging element adjacent respective opposite faces thereof.

In a further embodiment of the invention a water collecting tray is located adjacent
5 each water engaging element for collecting water from the water engaging element, when the water engaging element is extending out of the stream of flowing water. Preferably, each water collecting tray is located adjacent the connection of the corresponding water engaging element with the linearly moveable element.

10 In another embodiment of the invention each water engaging element is of length greater than the spacing between the pairs of first and second primary carrier elements.

In a further embodiment of the invention the linearly moveable element is adapted to
15 move with rectilinear motion.

Preferably, each water engaging element is coupled to the linearly moveable element to move with rectilinear motion.

20 In one embodiment of the invention the mounting means comprises at least one float for maintaining the chassis floating on the stream of flowing water. Preferably, the mounting means comprises a pair of spaced apart floats, and the chassis is mounted on and carried on the floats.

25 In another embodiment of the invention each float comprises an elongated float.

Preferably, the floats are located on respective opposite sides of the chassis, and are adapted to extend in a direction substantially parallel to the direction of linear motion of the linearly moveable element. Advantageously, the floats are adapted for
30 mounting the chassis above the water level with the respective water engaging elements extending downwardly into the stream of flowing water.

In another embodiment of the invention at least one coupling means is provided on

one of the chassis and the at least one float, the coupling means being adapted for coupling to an anchor cable. Preferably, one coupling means are provided on adjacent ends of the respective floats. Advantageously, one coupling means is provided on each end of each float.

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In one embodiment of the invention the converting means is adapted for converting kinetic energy in a stream of flowing water resulting from tidal flow in an ocean to rotational energy.

- 10 In another embodiment of the invention the converting means is adapted for converting kinetic energy in a stream of flowing water resulting from flow of water in a river.

- 15 The invention also provides a hydroelectricity generator comprising an energy converter according to the invention, and an electricity generator adapted to be powered by the rotational energy produced on the output shaft of the converting means.

- 20 Further the invention provides a method for converting kinetic energy in a stream of flowing water to rotational energy, the method comprising providing a chassis, providing a converting means adapted for converting linear motion into rotational motion, mounting the converting means on the chassis, and providing the converting means in the form of a linearly moveable element and a rotatably mounted output shaft with the linearly moveable element co-operating with the output shaft for
- 25 rotating the output shaft for producing the rotational motion from the linear motion, coupling at least one water engaging element to the linearly moveable element, and mounting the chassis relative to the stream of flowing water with the at least one water engaging element extending into the stream of flowing water, so that the at least one water engaging element is responsive to water flow therein for imparting
- 30 linear motion to the linearly moveable element.

The advantages of the hydroelectricity generator and the energy converter according to the invention are many. One of the advantages of the energy converter, whether

it is used as an energy converter or as an electricity generator, lies in its simplicity. The energy converter is of relatively simple straightforward construction, and includes the minimum of moving parts, thereby producing an energy converter and an electricity generator which requires minimum maintenance and servicing. A particularly important advantage of the energy converter according to the invention is that the energy converter is particularly suitable for use in applications where the available kinetic energy from flowing water is relatively low, and in particular, the energy converter is particularly suitable for use in relatively small rivers, and in applications where the velocity of the stream of flowing water is relatively low. The energy converter is also suitable for tidal applications relatively close to shore. However, as well as being suitable for use in relatively small rivers and tidal applications close to shore, the energy converter is also suitable for use in relatively large rivers and offshore tidal applications. A further advantage of the invention is that the energy converter according to the invention does not require a head of water for its operation, and thus, damming of a river is not required. The energy converter can be scaled up or down, and thus, is suitable for large scale applications and small scale applications, as well as medium size applications.

The hydroelectricity generator according to the invention is suitable for similar applications to those for which the energy converter according to the invention is suitable, and the advantages of the hydroelectricity generator according to the invention are similar to those achieved by the energy converter according to the invention. A particularly important advantage of the hydroelectricity generator is that the hydroelectricity generator can be produced to many scales, both large scale, small scale and medium scale applications, and can be readily and easily produced to be of any suitable size. For example, the hydroelectricity generator may be suitable for producing electricity to meet relatively small demands, such as, for example, the demand of a single domestic dwelling, or a group of domestic dwellings, an industrial unit or a group of industrial units, or a combination of industrial units and domestic dwellings. The hydroelectricity generator according to the invention is also suitable for use by electricity utility for producing electricity on a large scale basis. A further advantage of the hydroelectricity generator according to the invention is that the hydroelectricity generator may be adapted for connecting

into a mains electricity supply grid.

The advantages of the method according to the invention for converting kinetic energy in a stream of flowing water to rotational energy are similar to those achieved
5 by the energy converter according to the invention.

The invention will be more clearly understood from the following description of some preferred embodiments thereof which are given by way of example only with reference to the accompanying drawings, in which:

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Fig.1. is a side elevational view of a hydroelectricity generator according to the invention

Fig.2. is a top plan view of the hydroelectricity generator of Fig.1,

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Fig. 3. is a side elevational view of a detail of the hydroelectricity generator of Fig.1,

Fig. 4 is a view similar to Fig. 1 of a hydroelectricity generator according to
20 another embodiment of the invention,

Fig. 5 is a side elevational view of a detail of the hydroelectricity generator of Fig. 4,

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Fig. 6 is an end elevational view of a portion of the detail of Fig. 5 of the hydroelectricity generator of Fig. 4,

Fig. 7 is an end elevational view of a portion of the detail of Fig. 5 of the hydroelectricity generator of Fig. 4, and

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Fig. 8 is an end elevational view of another detail of the hydroelectricity generator of Fig. 4.

Referring to the drawings and initially to Figs. 1 to 3 thereof, there is illustrated a hydroelectricity generator according to the invention indicated generally by the reference numeral 1 for generating electricity from kinetic energy in a stream of flowing water, for example, from water flow in a river, tidal flow in an ocean or the like. The hydroelectricity generator 1 comprises an energy converter also according to the invention, indicated generally by the reference numeral 2, for converting kinetic energy in a stream of flowing water to rotational energy. The energy converter 2 comprises a chassis 3 which is mounted on a mounting means comprising a pair of spaced apart longitudinally extending elongated floats 4 for supporting the chassis 3 above the water level. The chassis 3 comprises a pair of spaced apart side frames 5 of steel which are joined together by transverse members (not shown) also of steel. The floats 4 are located on opposite sides of the chassis 3, and are connected to the chassis 3 by struts 6 which extend sidewardly outwardly and downwardly from the side frames 5 of the chassis 3. The struts 6 are illustrated in Fig. 2 only. Each side frame 5 comprises longitudinally extending top and bottom members 7 and 8, respectively, which are joined at their respective opposite ends by end members 9 of arcuate shape.

A pair of spaced apart transversely extending shafts, namely, an output shaft 10 and an idler shaft 11 are rotatably mounted in the side frames 5 and extend between the side frames 5. Mounting members (not shown) are provided in the side frames 5 extending between the top and bottom members 7 and 8 for rotatably carrying the output and idler shafts 10 and 11 in bearings (not shown). The output shaft 10 carries a pair of spaced apart first primary carrier elements, which in this embodiment of the invention comprise a pair of spaced apart first primary sprockets 12, which are mounted fast on the output shaft 10. The idler shaft 11 carries a pair of spaced apart second primary carrier elements, which in this embodiment of the invention comprise a pair of spaced apart second primary sprockets 13, which are mounted fast on the idler shaft 11.

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A converting means comprising a converter 15 for converting linear motion to rotational motion comprises a pair of spaced apart linearly moveable elements, namely, a pair of endless primary transmission elements provided by a pair of

primary transmission chains 16 which extend around and are carried on corresponding ones of the first and second primary sprockets 12 and 13, so that as the primary transmission chains 16 move with rectilinear motion in the direction of the arrow A, the rectilinear motion of the primary transmission chains 16 is converted
5 to rotational motion of the output shaft 10 in order to produce rotational energy.

A plurality of water engaging elements, namely, water engaging paddles 17 are coupled to the primary transmission chains 16 and are longitudinally spaced apart along the primary transmission chains 16. The water engaging paddles 17 extend
10 between the side frames 5, and the water engaging paddles 17 on the lower legs 19 of the primary transmission chains 16 extend downwardly into the stream of flowing water, so that the action of the flowing water in the direction of the arrow A, of Fig. 1 urges the water engaging paddles 17 on the lower legs 19 of the primary transmission chains 16 with rectilinear motion in the direction of the arrow A. In turn
15 the lower legs 19 of the primary transmission chains 16 are also urged in the direction of the arrow A with rectilinear motion, so that the rectilinear motion of the lower legs 19 of the primary transmission chains 16 is converted into rotational energy of the output shaft 10 and the idler shaft 11.

20 An electricity generator 20 is mounted on the chassis 3 between the side frames 5, and is driven by the output shaft 10 through a secondary transmission means, which comprises a gearbox 21 and a secondary chain and sprocket transmission 22 through which drive is transmitted from the output shaft 10 to the gearbox 21. The gearbox 21 is also mounted on the chassis 3 between the side frames 5, and the
25 electricity generator 20 is driven by a transmission shaft 23 extending from the gearbox 21. The secondary chain and sprocket transmission 22 comprises a drive sprocket 24 which is mounted fast on the output shaft 10 and a driven sprocket 25 which is fast on an input shaft 27 of the gearbox 21. A secondary transmission chain 28 around the drive sprocket 24 and the driven sprocket 25 transmits drive from the
30 output shaft 10 to the input shaft 27 of the gearbox 21.

Returning now to the water engaging paddles 17, each water engaging paddle 17 extends from a transversely extending carrier member 30 which extends between

and is secured to the primary transmission chains 16. The water engaging paddles 17 are of arcuate shape and are coupled to the primary transmission chains 16 by the corresponding carrier members 30 to be of concave shape when viewed from the direction of water flow for maximising the capture of the kinetic energy of the flowing water. A water collecting channel 31 extends along the length of each carrier member 30 for collecting water from the corresponding water engaging paddle 17 as the water engaging paddle 17 is extending upwardly from upper legs 33 of the primary transmission chains 16.

10 A stabilising means, for stabilising the primary transmission chains 16 adjacent each water engaging paddle 17 comprises two stabilising rollers 34 which are located at respective opposite sides of each carrier member 30 for rotatably engaging respective corresponding guide tracks 35, see Fig. 3 extending inwardly from the side frames 5, so that as the primary transmission chains 16 are urged by the action of the flowing water on the water engaging paddles 17 the stabilising rollers 34 engage the guide tracks 35 for stabilising the primary transmission chains 16, and for controlling the torque from the water engaging paddles 17, to thereby prevent any slack occurring in the primary transmission chains 16.

20 Four coupling means comprising coupling elements 38 are provided at the respective opposite ends of the floats 4 for receiving anchor cables (not shown) for anchoring the hydroelectricity generator 1 in the stream of flowing water. In the event of the hydroelectricity generator 1 being located in a river, anchor cables would be coupled to each of the four coupling elements 38 and would be anchored to the river bank, or the river bed, as the case may be for retaining the hydroelectricity generator 1 longitudinally orientated relative to the flow of water and for maintaining the hydroelectricity generator 1 centrally in the stream of flowing water. On the other hand, where the hydroelectricity generator 1 is located in the sea, for example, in a tidal estuary only two of the coupling elements 38 would be used at one end of the hydroelectricity generator 1 so that the hydroelectricity generator 1 could swing around on each turn of the tide.

In use, the hydroelectricity generator 1 is maintained floating on the water by the

floats 4 with the chassis 3 above the water level and the water engaging paddles 17 on the lower legs 19 of the primary transmission chains 16 extending downwardly into the stream of flowing water, be it a river or tidal flow. The hydroelectricity generator 1 is appropriately anchored by anchor cables (not shown) coupled to the appropriate ones of the coupling elements 38. As discussed above all four of the coupling elements 38 are used when the hydroelectricity generator 1 is located in a river, and only two of the coupling elements 38 at one end of the hydroelectricity generator 1 are used when the hydroelectricity generator 1 is located in a tidal flow. The two coupling elements 38 which are used for anchoring the hydroelectricity generator 1 in a tidal flow are the coupling elements 38a at the forward end 39 of the hydroelectricity generator 1.

As the stream of water flowing in the direction of the arrow A acts on the water engaging paddles 7 extending downwardly from the lower legs 19 of the primary transmission chains 16, the water engaging paddles 7 are urged with rectilinear motion in the direction of the arrow A, thereby causing the primary transmission chains 16 to rotate the output shafts 10 and idler shaft 11. Drive from the output shaft 10 is transmitted through the secondary chain and sprocket transmission 22 to the gearbox 21, and in turn to the electricity generator 20 for driving thereof. Electricity from the electricity generator 20 is relayed to a land based station by suitable cables (not shown).

The hydroelectricity generator 1 may be produced to any scale, from smaller scale versions to the larger scale versions. For example, it is envisaged that a relatively small scale version of the electricity generator 1 would be of length of approximately five metres and width of approximately three to four metres. The dimensions of larger scale hydroelectricity generators according to the invention within reason could be of any desirable length and width. It is envisaged that a medium size hydroelectricity generator according to the invention would be of size of approximately twelve metres in length by ten metres in width. However, the hydroelectricity generator according to the invention, and the energy converter according to the invention are not to be limited to any particular dimensions.

Referring now to Figs. 4 to 8, there is illustrated a hydroelectricity generator according to another embodiment of the invention, indicated generally by the reference numeral 40. The hydroelectricity generator 40 is substantially similar to the hydroelectricity generator 1 and similar components are identified by the same reference numerals. The main difference between the hydroelectricity generator 40 and the hydroelectricity generator 1 is in the primary transmission element, and the first and second primary carrier elements. In this embodiment of the invention the primary transmission element, instead of being provided by a primary transmission chain, comprises a primary transmission belt in the form of an endless steel rope 41 which is carried around first and second primary pulleys 43 and 44, respectively, which are mounted fast on the output shaft 10 and the idler shaft 11, respectively. In this embodiment of the invention slots 45 are cut into each water engaging paddle 17 in order to accommodate the first and second primary pulleys 43 and 44 as the water engaging paddles 17 are being carried around the first and second primary pulleys 43 and 44. Pairs of abutment elements 46, which extend radially from the second primary pulleys 44 at equi-spaced apart intervals of 90° circumferentially engage the water engaging paddles 17 should the steel ropes 41 slip in the first and second primary pulleys 43 and 44, in order to minimise slippage between the ropes 41 and the first and second primary pulleys 43 and 44. Clamps 47 in the slots 45 engage the steel ropes 41 for clamping the water engaging panels 17 onto the ropes 41 at longitudinally spaced apart intervals.

In order to minimise slippage of the ropes 41 in the first and second primary pulleys 43 and 44, grooves 48 of the respective first and second primary pulleys 43 and 44 are lined with a rubber lining 49. The provision of the rubber lining 49 in the grooves 48 of the first and second primary pulleys 43 and 44 as well as minimising slip between the ropes 41 and the first and second primary pulleys 43 and 44 also reduces transmission noises between the ropes 41 and the first and second primary pulleys 43 and 44.

Otherwise, the electricity generator 40 and its use is similar to that already described with reference to the hydroelectricity generator 1 of Figs. 1 to 3.

While the water engaging paddles 17 have been described as being coupled to the corresponding carrier members 30, it is envisaged in certain cases, that the water engaging paddles 17 may be pivotally coupled to the corresponding carrier members 30 so that the angle of attack of the water engaging paddles 17 to the flowing water could be selectively varied to compensate for variation in the flow rate of the stream of flowing water in order to maintain the speed at which the electricity generator 20 is driven substantially constant as the speed and kinetic energy of the flowing water varies. Alternatively it is envisaged that the chassis may be mounted on the floats to facilitate raising and lowering the chassis 3 relative to the floats 4, for in turn varying the area of the water engaging paddles 17 available to the flowing water, for similarly accommodating variation in the speed and kinetic energy of the flowing water. For example, the chassis may be carried on hydraulic or pneumatic rams mounted on the floats for raising and lowering the chassis relative to the floats. Alternatively, a screw-jack or screw-jack means may be provided for raising and lowering the chassis relative to the floats. When the chassis is raisable and lowerable relative to the floats, it is envisaged that maintenance of the hydroelectricity generator could be carried out with the chassis raised. As well as adjusting the height of the chassis relative to the floats for adjusting the area of the water engaging paddles 17 available to the flowing water, the level of the chassis relative to the floats would also be adjustable in order to avoid the water engaging paddles 17 touching the river bed or the sea bed. Such adjustment could be carried out when the hydroelectricity generator is being installed, and suitable control apparatus could also be provided for adjusting the level of the chassis above the floats in response to a falling or rising tide or a flooded river and the like.

25

It is also envisaged that in certain cases the paddles may be replaceable with paddles of different size, similarly to accommodate variation in the kinetic energy and speed of the flowing water.

30 While the electricity generator has been described as being mounted on the chassis, the electricity generator may be mounted in any suitable location, and it is envisaged that in certain cases the electricity generator may be land mounted and in which case, an hydraulic or a pneumatic pump would be driven either directly or indirectly

by the output shaft 10. An hydraulic or a pneumatic motor would be land mounted and coupled to the corresponding one of the hydraulic pump and the pneumatic pump for driving thereof through suitable hydraulic or pneumatic piping. The one of the hydraulic motor and the pneumatic motor would be mechanically coupled either
5 directly or through a gearbox to the electricity generator, which would also be land based for generating electricity.

It is also envisaged that the hydroelectricity generator 1 according to the invention would be housed in a suitable protective housing for protecting the hydroelectricity
10 generator from weather and other environmental hazards. The housing could be of any suitable material, for example, fibreglass, light gauge steel sheeting and the like. It is also envisaged that a strong steel mesh protective guard would be located adjacent the front of the hydroelectricity generator in order to protect the
hydroelectricity generator from flotsam, such as floating debris, trees, branches of
15 trees and the like. It is also envisaged that channel iron steel may be secured to the floats. Indeed, it is also envisaged that Y-section steel and heavier channels may also be secured to the floats.

While the chassis has been described as being of steel, the chassis may be of any
20 suitable material. Needless to say the floats 4 may also be of any suitable material, and typically, would be of a plastics material and may be formed by any suitable plastics forming process, for example, rotational moulding or the like. The water engaging paddles may be of any suitable material, and typically, would be of a relatively rigid plastics material.

25 While the energy converter according to the invention has been described for use in conjunction with an hydroelectricity generator, it is envisaged that the energy converter according to the invention may be used in other applications besides that of generating electricity. In which case, the rotational energy would be derived from
30 the output shaft of the energy converter to drive other components.

Claims

1. An energy converter for converting kinetic energy in a stream of flowing water to rotational energy, the energy converter comprising a chassis, a converting means adapted for converting linear motion into rotational motion, the converting means
5 being mounted on the chassis and comprising a linearly moveable element and a rotatably mounted output shaft, the linearly moveable element co-operating with the output shaft for rotating the output shaft for producing the rotational motion from the linear motion, at least one water engaging element coupled to the linearly moveable element and adapted to extend into the stream of flowing water and being
10 responsive to water flow therein for imparting linear motion to the linearly moveable element, and a mounting means adapted for maintaining the chassis relative to the stream of flowing water with the at least one water engaging element extending into the stream of flowing water.
- 15 2. An energy converter as claimed in Claim 1 in which the mounting means is adapted for maintaining the chassis relative to the stream of flowing water with the at least one water engaging element extending transversely of the direction of flow of the stream of flowing water.
- 20 3. An energy converter as claimed in Claim 1 or 2 in which the linearly moveable element comprises at least one endless primary transmission element carried on and extending around corresponding spaced apart rotatably mounted first and second primary carrier elements.
- 25 4. An energy converter as claimed in Claim 3 in which each first primary carrier element is mounted fast on the output shaft.
5. An energy converter as claimed in Claim 3 or 4 in which each second primary carrier element is mounted fast on a rotatably mounted idler shaft spaced apart from
30 and extending parallel to the output shaft.
6. An energy converter as claimed in any of Claims 3 to 5 in which a pair of spaced apart primary transmission elements are provided, each primary

transmission element being carried on a corresponding pair of first and second primary carrier elements.

7. An energy converter as claimed in any of Claims 3 to 6 in which each primary
5 transmission element comprises a primary transmission chain, and the first and second primary carrier elements comprise respective first and second primary sprockets.

8. An energy converter as claimed in any of Claims 3 to 6 in which each primary
10 transmission element comprises a primary transmission belt, and the first and second primary carrier elements comprise respective first and second primary transmission pulleys.

9. An energy converter as claimed in Claim 8 in which each primary
15 transmission belt comprises a primary transmission rope.

10. An energy converter as claimed in Claim 9 in which each primary transmission rope comprises a steel transmission rope.

20 11. An energy converter as claimed in any preceding claim in which a secondary transmission means is provided for transmitting the rotational motion from the output shaft to one of an hydraulic pump, a pneumatic pump and an electricity generator.

12. An energy converter as claimed in Claim 11 in which an hydraulic pump is
25 mounted on the chassis and is driven by the secondary transmission means.

13. An energy converter as claimed in Claim 12 in which the hydraulic pump is adapted for driving an hydraulic motor.

30 14. An energy converter as claimed in Claim 13 in which the hydraulic motor is adapted for mounting remote of the energy converter.

15. An energy converter as claimed in Claim 13 or 14 in which the hydraulic

motor is adapted for land mounting.

16. An energy converter as claimed in any of Claims 13 to 15 in which the hydraulic motor is adapted for coupling to an electricity generator for generating
5 electricity.

17. An energy converter as claimed in Claim 11 in which a pneumatic pump is mounted on the chassis and is driven by the secondary transmission means.

10 18. An energy converter as claimed in Claim 17 in which the pneumatic pump is adapted for coupling to a pneumatic motor.

19. An energy converter as claimed in Claim 18 in which the pneumatic motor is adapted for mounting remote of the energy converter.

15 20. An energy converter as claimed in Claim 18 or 19 in which the pneumatic motor is adapted for land mounting.

21. An energy converter as claimed in any of Claims 18 to 20 in which the
20 pneumatic motor is adapted for coupling to an electricity generator for producing electricity.

22. An energy converter as claimed in Claim 11 in which an electricity generator is mounted on the chassis and is driven by the secondary transmission means.

25 23. An energy converter as claimed in any of Claims 11 to 22 in which the secondary transmission means comprises a gearbox.

24. An energy converter as claimed in Claim 23 in which the one of the hydraulic
30 pump, the pneumatic pump and the electricity generator is driven through the gearbox.

25. An energy converter as claimed in any of Claims 11 to 24 in which the

secondary transmission means comprises a secondary transmission element carried on and extending around first and second secondary carrier elements, the first secondary transmission elements being mounted fast on the output shaft, and the second secondary carrier element being mounted fast on an input shaft of the gearbox or an input shaft of one of the hydraulic pump, the pneumatic pump and the electricity generator.

26. An energy converter as claimed in Claim 25 in which the secondary transmission element comprises a secondary transmission chain, and the first and second secondary carrier elements comprise first and second secondary sprockets, respectively.

27. An energy converter as claimed in any preceding claim in which a plurality of water engaging elements are coupled to the linearly moveable element spaced apart longitudinally along the linearly moveable element.

28. An energy converter as claimed in any preceding claim in which each water engaging element extends transversely of each primary transmission element.

29. An energy converter as claimed in any preceding claim in which each water engaging element comprises a water engaging paddle.

30. An energy converter as claimed in Claim 29 in which each water engaging paddle is of arcuate shape.

31. An energy converter as claimed in Claim 29 or 30 in which each water engaging paddle is concave when viewed from the direction of water flow in the stream of flowing water.

32. An energy converter as claimed in any preceding claim in which each water engaging element is pivotally coupled to the linearly moveable element.

33. An energy converter as claimed in Claim 32 in which an adjustment means is

provided for selectively adjusting the angle of attack of each water engaging element relative to the linearly moveable element.

34. An energy converter as claimed in any preceding claim in which a stabilising
5 means is provided for stabilising the linearly moveable element adjacent each water engaging element.

35. An energy converter as claimed in Claim 34 in which each stabilising means
10 comprises at least one stabilising roller adjacent the linearly moveable element engageable with a track extending parallel to the linearly moveable element.

36. An energy converter as claimed in Claim 35 in which a pair of spaced apart
guide tracks are provided on respective opposite sides of the linearly moveable
element for engaging respective opposite ends of each stabilising roller.

15 37. An energy converter as claimed in Claim 36 in which each stabilising roller extends outwardly at respective opposite side edges of the water engaging element for engaging an adjacent one of the guide tracks.

20 38. An energy converter as claimed in any of Claims 35 to 37 in which a pair of stabilising rollers are provided adjacent each water engaging element adjacent respective opposite faces thereof.

39. An energy converter as claimed in any preceding claim in which a water
25 collecting tray is located adjacent each water engaging element for collecting water from the water engaging element, when the water engaging element is extending out of the stream of flowing water.

40. An energy converter as claimed in Claim 39 in which each water collecting
30 tray is located adjacent the connection of the corresponding water engaging element with the linearly moveable element.

41. An energy converter as claimed in any preceding claim in which each water

engaging element is of length greater than the spacing between the pairs of first and second primary carrier elements.

42. An energy converter as claimed in any preceding claim in which the linearly
5 moveable element is adapted to move with rectilinear motion.

43. An energy converter as claimed in any preceding claim in which each water
engaging element is coupled to the linearly moveable element to move with
rectilinear motion.

10

44. An energy converter as claimed in any preceding claim in which the mounting
means comprises at least one float for maintaining the chassis floating on the stream
of flowing water.

15 45. An energy converter as claimed in Claim 44 in which the mounting means
comprises a pair of spaced apart floats, and the chassis is mounted on and carried
on the floats.

46. An energy converter as claimed in Claim 44 or 45 in which each float
20 comprises an elongated float.

47. An energy converter as claimed in any of Claims 44 to 46 in which the floats
are located on respective opposite sides of the chassis, and are adapted to extend in
a direction substantially parallel to the direction of linear motion of the linearly
25 moveable element.

48. An energy converter as claimed in any of Claims 44 to 47 in which the floats
are adapted for mounting the chassis above the water level with the respective water
engaging elements extending downwardly into the stream of flowing water.

30

49. An energy converter as claimed in any of Claims 44 to 48 in which at least
one coupling means is provided on one of the chassis and the at least one float, the
coupling means being adapted for coupling to an anchor cable.

50. An energy converter as claimed in Claim 49 in which one coupling means are provided on adjacent ends of the respective floats.

5 51. An energy converter as claimed in Claim 49 or 50 in which one coupling means is provided on each end of each float.

52. An energy converter as claimed in any preceding claim in which the converting means is adapted for converting kinetic energy in a stream of flowing
10 water resulting from tidal flow in an ocean to rotational energy.

53. An energy converter as claimed in any preceding claim in which the converting means is adapted for converting kinetic energy in a stream of flowing water resulting from flow of water in a river.

15 54. A hydroelectricity generator comprising an energy converter as claimed in any preceding claim, and an electricity generator adapted to be powered by the rotational energy produced on the output shaft of the converting means.

20 55. A method for converting kinetic energy in a stream of flowing water to rotational energy, the method comprising providing a chassis, providing a converting means adapted for converting linear motion into rotational motion, mounting the converting means on the chassis, and providing the converting means in the form of a linearly moveable element and a rotatably mounted output shaft with the linearly
25 moveable element co-operating with the output shaft for rotating the output shaft for producing the rotational motion from the linear motion, coupling at least one water engaging element to the linearly moveable element, and mounting the chassis relative to the stream of flowing water with the at least one water engaging element extending into the stream of flowing water, so that the at least one water engaging
30 element is responsive to water flow therein for imparting linear motion to the linearly moveable element.

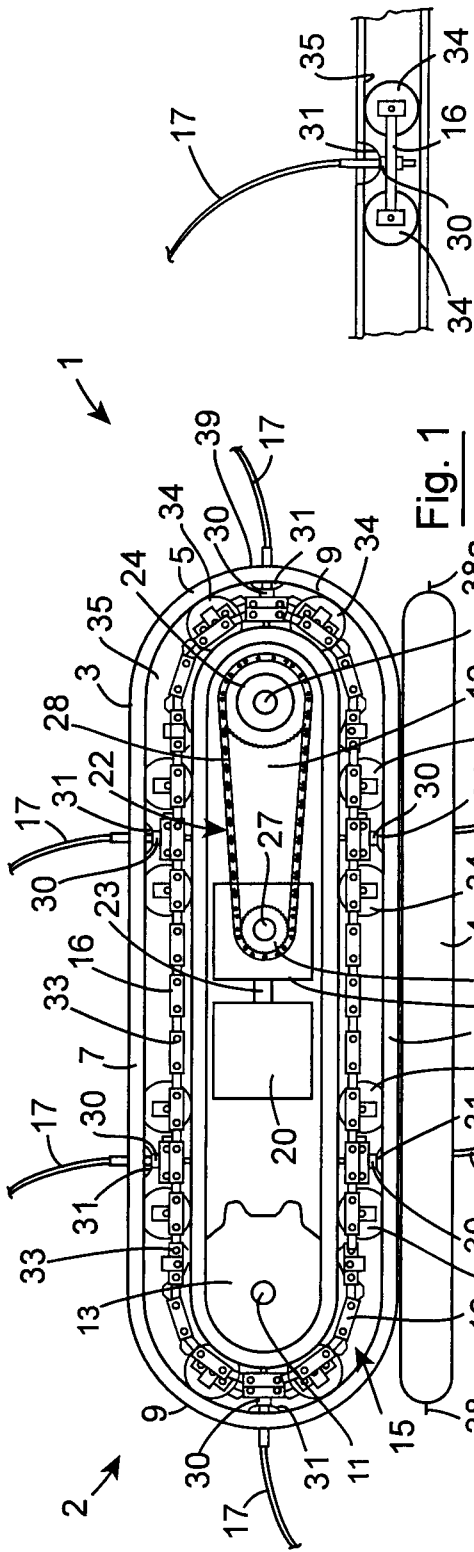


Fig. 1

Fig. 3

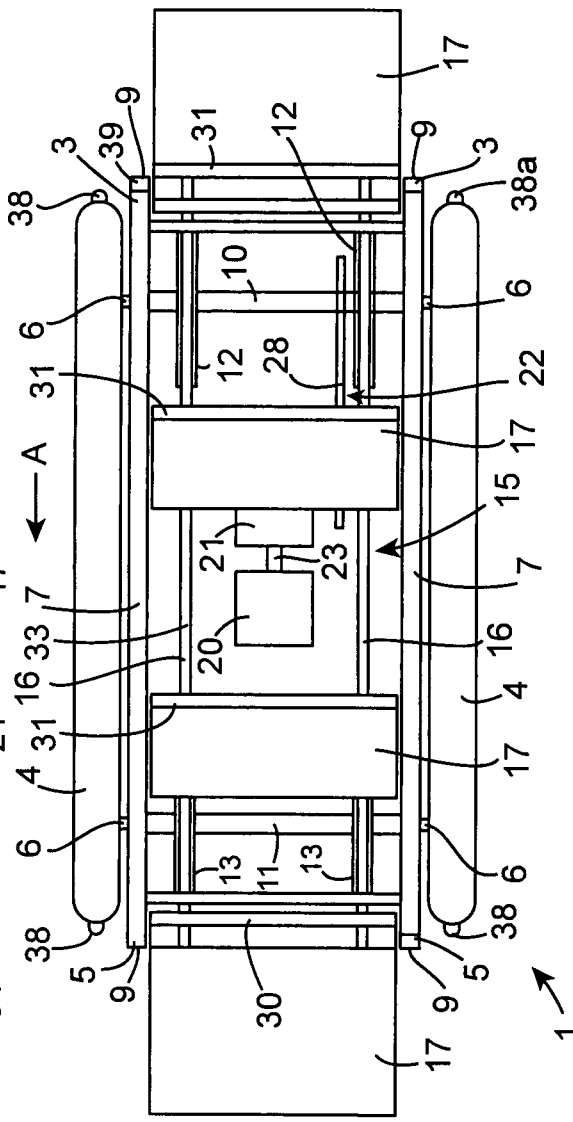


Fig. 2

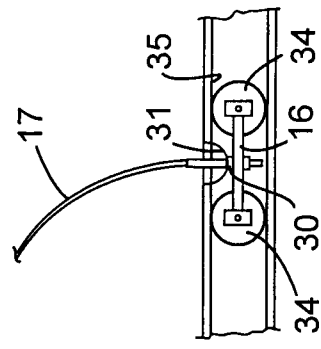


Fig. 3

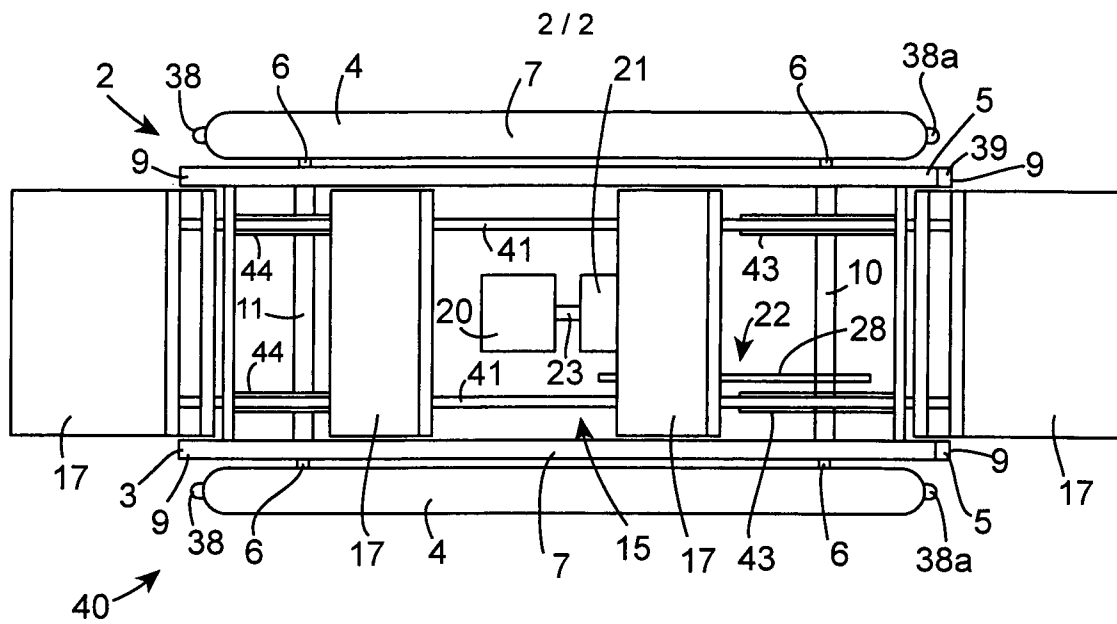


Fig. 4

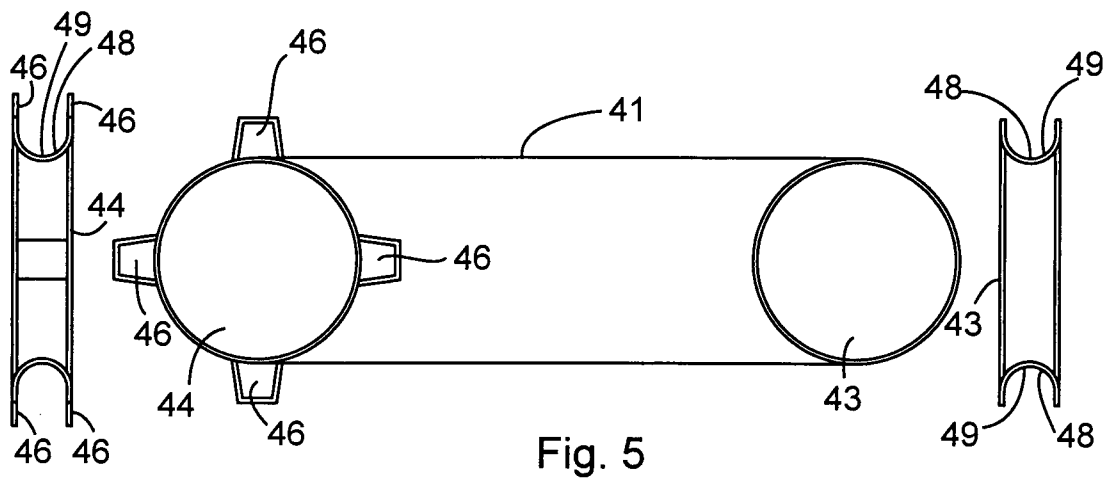


Fig. 6

Fig. 7

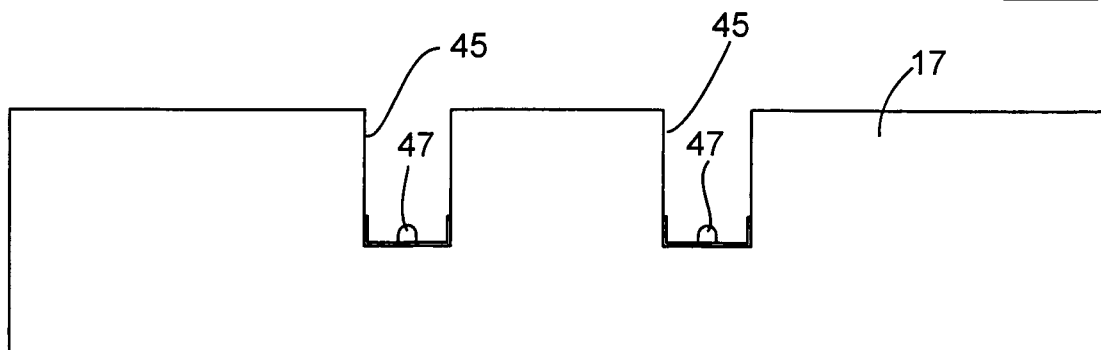


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/IE2011/000042

A. CLASSIFICATION OF SUBJECT MATTER

INV. F03B13/26 F03B17/06 F03B9/00
ADD.

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, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 20 2006 013818 U1 (WINTERFELD HELMUTH [DE]) 14 December 2006 (2006-12-14) the whole document	1-5,11, 22-29, 31,39, 40,42-55
X	DE 33 38 132 A1 (TEMECO PROJECTS HANDELSGESELLS [DE]) 9 May 1985 (1985-05-09) page 7, paragraph 4 - page 9, paragraph 3; claims 1,3,4,7; figures 1A-1C,4 ----- -/-	1-11, 27-31, 34-55



Further documents are listed in the continuation of Box C.



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Date of the actual completion of the international search

20 October 2011

Date of mailing of the international search report

27/10/2011

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INTERNATIONAL SEARCH REPORT

International application No

PCT/IE2011/000042

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 184 807 A (BERG GEORGE W [CA]) 22 January 1980 (1980-01-22) page 1, line 11 - line 31; figures 1-7 -----	1-7, 11-16, 27-29, 34,39, 40, 42-48, 52-55
X	DE 10 2008 015660 A1 (ROES HELMUT [DE]) 1 October 2009 (2009-10-01) paragraphs [0005], [0006], [0019], [0032] - [0041]; figures 1-5 -----	1,2, 11-22, 27-30, 32-38, 42-44, 52-55

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IE2011/000042

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 202006013818 U1	14-12-2006	NONE	
DE 3338132	A1	09-05-1985	NONE
US 4184807	A	22-01-1980	NONE
DE 102008015660 A1	01-10-2009	NONE	