SYSTEM AND METHOD FOR CONVERSION OF WAVE ENERGY INTO ELECTRICAL ENERGY

Technical Field

The present disclosure relates, generally, to the utilization of energy from waves and converting the linear motion of waves into operating motion of a generator which then produces electricity. According to the present disclosure, this system uses a floating working body for conversion of linear motion of aquatic waves either into circular or linear motion of the generator.

The present disclosure answers the following question: What is the most practical solution for construction of a system for converting the wave energy into electrical energy?

Background Art

Modern systems for electrical energy production are very expensive, and many of them use unrenewable fossil fuels and pollute the environment a great deal. The Planet is endangered by the global warming and the greenhouse effect. This leads to the question of electrical energy production by utilization of the natural, renewable wave energy.

Today the wave energy is not used for production of electrical energy, except experimentally. Power plants are limited by the amount of available ore used as operating force for turbines and at the same time they are big environmental pollutants. Nuclear power plants are large energy sources but they can be very dangerous if they get damaged (Chernobyl and some plants in the USA, for example). By emitting large amounts of water vapour into atmosphere they increase global pollution; there is also a very serious problem with the nuclear waste disposal.

Alternatively, electricity is produced in electric plants built on river and lake dams. However the construction of those plants is complex and expensive. Costal countries cannot use this source for electricity production. The only solution for these countries is utilization of wave energy.

Previous attempts of utilization of wave energy for electricity production have not succeeded due to some particular disadvantages and have not been put in practice.

The American patent # 1, 393, 472 from the year 1921 was an attempt to use the wave energy to shift a platform up and down in a very complex way with a large number of gears that used to cause great energy loss. This resulted in extremely low power on the outlet. Because of limited free motion of the platform, possible jamming, bumping and accidence, this patent was never put in practice. The engine of this patent consists of numerous parts and the platform is very heavy with substantial inertia.

There were also some other attempts, such as the US patent #5, 710, 464 from 1998, which is an interesting example of utilization of energy from waves for the operation of the pumps for electrical generator supply. In this invention pumps drove sea water through pipes to electrical generator which generated electricity.

Likewise, both US patents # 4, 232, 230 and # 4, 672, 222 were the attempts to produce electrical energy by use of linear motion of electromagnets. But the costs of the spare parts production were high; the maintenance was expensive and complex because the induction generator was below water surface which increased the production and exploitation costs.

Compared to previous patents, these were certainly much better, but yet uncompleted.

In comparison to previous inventions this is an advanced invention because maximal water power is utilized and conversed into electrical energy with minimal losses in the transmission system. By mutually positioned and arranged sets of floating bodies maximal energy of aquatic waves is utilized and the sea is "ironed".

The induction coil magnet is directly connected to the floating bodies. With the arrangement with rotary generator minimal losses in the transmission system are obtained by use of one-way clutches.

Disclosure of the Invention

Presented invention is a system for producing electrical energy which enables great efficiency in conversion of aquatic wave motion into electrical generator motion. Devices and components necessary for assembling the system are well-known, cheap and can be made or collected in economical production.

In contrast to the previously mentioned US patents # 4, 232, 230 and # 4, 672, 222 where the induction generators are positioned under water surface, in our invention the induction generator is positioned above the water surface, above the floating working body, for example, not below the floating working body as in the US patents mentioned above.

The present energy generating system includes a floating body, a transmission shaft, units for fixing the system to the sea bottom, a beam with devices for producing electrical energy. Contrary to the US patent 1, 393, 472 the system for electrical energy production is not positioned on the floating body, but on the fixed columns. This way the system for conversion of the linear motion of the floating body into rotary motion is much simpler, with less machine parts; with one-way clutches that transmit rotating moment only in one direction, not the opposite one. There are no similarities between our invention and other mentioned patents.

The floating body floats on the water and is placed between fixed parts (two or three columns) and, under the action of the waves, moves up and down. The transmission shaft, which can be flexible or inflexible, is fixed to the floating body. The transmission shaft transmits motion to the generator for electrical energy production. Electrical energy can be produced either by use of an induction coil or a generator.

The motion of the magnet in the induction coil is directly related to the motion of the floating body either through the flexible transmission shaft or through inflexible transmission shaft. The induction coil is placed above the water surface and above the working body. In this arrangement, this is the simplest way of electrical energy production.

The energy generating system produces electrical energy by allowing the floating body to move up and down under the action of the waves. Since the floating body is directly connected to the generator by the transmission shaft it causes linear motion of the magnet in the induction coil to produce electrical energy. Alternatively, the linear motion of the transmission shaft can be converted into circular motion by a rotary generator.

With the generator system the motion or the floating body is converted into circular motion in a very simple way with minimal losses in the transmission system and minimal number of machine parts of the generator for producing electrical energy.

In one illustrative embodiment, the production of electrical energy from the wave motion can be accomplished without any parts secured to the bed of the body of water. In this arrangement, the central floating body is encircled by external floating bodies at such

distance, that when the central floating body is on the bottom of the wave, the external floating bodies are on the top of the wave and vice versa. The central floating body is connected to the device for production of electrical energy, as it has previously been described (a generator or an induction coil with the supporting mechanism). The external floating bodies can extend or retract from the central floating body depending on the lengths of the waves. The distance between the outside floats correspond to the length of the waves, so the maximum utilization of the system is obtained.

Brief Discription of the Drawings

The present invention and the advantages thereof will become more apparent upon consideration of the following detailed description when taken in conjunction with the accompanying drawings of which:

Fig. 1 shows the system for electrical energy production with the light floating body according to this invention.

Fig. 2 is a schematic display of the energy generating system of Fig.1 moving under the influence of the waves.

Fig. 3 is an embodiment of the system of Fig.1 showing its front side in cross section.

Fig. 3a is a perspective view of the energy generating system of Fig. 3

Fig. 3b shows an axonometric section of a field of energy generating system and one variation of positioning floating bodies in the direction of the waves.

Fig. 3c is a top view of one of the possible arrangements of the floating bodies placed on the water surface.

Fig. 4 is an axonometric view with a partial cross section of another embodiment of the energy generating system of Fig.1 with the generator for electrical energy production.

Fig. 5 is an enlarged axonometric view of the energy generating system of Fig. 4, i.e. basic devices for conversion of linear motion into circular motion and its transmission to the generator.

Fig. 6 is an axonometric view with a partial cross section of another embodiment of the energy generating system of Fig. 1.

Fig. 6a is an axonometric view with a partial cross section of another embodiment of the energy generating system of Fig. 6

Fig. 7 is an axonometric view of the energy generating system of Fig. 4 with a large floating body.

Fig. 7a is a side view of the energy generating system of Fig. 7

Fig. 7b shows an axonometric view of the energy generating system of Fig.7 with pulleys with flexible transmission shafts positioned above the water surface.

Fig. 7c is an enlarged axonometric view of electrical energy generating system secured on the energy generating systems of Fig. 7, 7a and 7b.

Fig. 8a shows an axonometric way of positioning of the previous energy generating system in the direction of wave motion.

Fig. 8b is a top view of the energy generating system of Fig. 8a.

Fig. 9 shows an axonometric combination of a large floating body and induction coils used as energy converters.

Fig. 10a is a front, cross sectional view showing the shape of the floating body with the matched devices for shorter waves.

Fig. 10b is a top view of the electrical energy generating system of Fig. 10a.

Fig. 11 is an axonometric view showing electrical energy production by means of a large floating body with overhangs coupled to the racks,

Fig. 11a is an axonometric view showing a portion A of Fig. 11.

Fig. 11b is a side elevational view of the floating body with the electrical energy generating system.

Fig. 11c is a side view of the floating body with a bracket and an inflexible transmission shaft with the electrical energy generating system.

Fig. 11d is a top view of the floating body.

Fig. 11e shows a detail A of Fig.11d

Fig. 11f is a perspective view of the device of Fig. 11g

Fig. 11g is a top view of the device that converts the two-way operating motion into rotation of a spindle in the same direction by means of external gearing.

Fig. 12 is an axonometric view a portion of the floating body with a fixed transmission shaft positioned on the floating body and the electrical energy generating system.

Fig.12a is a sectional view of the portion of Fig.12

Fig. 12b is a sectional view of a floating body and a flexible transmission shaft connection.

Fig.12c is an enlarged sectional view of a portion A of Fig.12a

Fig.12d is enlarged sectional view of a portion B of Fig.12b

Fig. 13 is a perspective view of a portion of the electrical energy generating system without inflexible supports in the sea-bed.

Fig. 13a is a front, sectional view of the upper position of the floating bodies under action of the waves.

Fig. 13b shows a front, sectional view of the lower position of the floating bodies under action of the waves.

Fig.14 is a perspective view of the supporting beam 8 with the electrical energy generating system.

Detailed Description

Fig. 1 is a perspective view of the energy generating system with a light floating body 1a, according to the invention. In illustrative embodiments, the energy generating system includes two columns 7 secured to the bottom of the sea on one of its ends, and with the mechanism for moving the beam 9, on the other, free end. By use of guides on the basic column 13, the columns are coupled to a vertical beam 9 which is parallel to the water surface. To compensate for changes in tide, on the beam 9, a mechanism is used. The mechanism includes an electromotor 10, a reducer 11, a jack-screw 12 and a geared lath 8 which is coupled to the column 7. This mechanism, measured and controlled by a computer, lifts and lowers the beam 9. This is important for the areas where the difference in tide altitude is significant. This way the transmission shaft 2 does not have to be extremely long. By this system the oscillation of the magnet 4 around the central position of the induction coil 14 can be roughly kept. In the areas where the difference in tide altitude is minimal, the beam 9 can be fixed in relation to the columns 7. Fine alignment of the magnet is obtained by a lead-screw 5 which is swerved by use of a lead-screw drive 15. Magnet 4 starts moving in relation to the rod 2 when it gets drive from the lead screw 5. The motion of the magnet 4 should be monitored and supported by a computer.

In order to achieve permanent position of the transmission shaft 2 a bearing 16 is added. The transmission shaft passes through the bearing which accepts the lateral forces and enables proper leading of the magnet inside the induction coil

An innovation which provides minimal lateral forces on the transmission shaft 2 is introduced in this invention. The transmission shaft 2 is coupled to the floating body, below the central point of displacement by use of a hinge. Floating body 1a, in this embodiment, circular in cross section, takes free position in relation to the transmission shaft 2 and the buoyancy forces on the left and right sides of the transmission shaft are equal, so there is no lateral load on the transmission shaft. The upper part of the floating body is free and the contact between the floating body and the transmission shaft 2 must be avoided. In order to prevent water from entering into the floating body and to enable free shift of the floating body in relation to the transmission shaft 2, a waterproof, flexible membrane 6 is used. The way of securing of the membrane 6 to the floating body on the one side, and to the transmission shaft 2 on the other side, is well-known. Floating body should be as light as possible, so it is manufactured from lightweight materials such as a glass-fiber and plastic combination or fabricated from pneumatic balloons.

Operating mode: floating body rises when waves approach and vertical motion of the floating body is transmitted to a magnet 4 in the induction coil 14 by a transmission shaft 2. Electrical energy is generated inside the induction coil by motion of the magnet. Depending on the size of the floating body, the linear generator (magnet and induction coil) and the consumer are sized-up. It has to be taken into consideration that the working stroke is when the floating body shifts vertically upwards, and when the floating body shifts vertically downwards, the linear generator has to be unloaded to enable floating body to move downwards and follow the motion of the waves.

Fig. 2 is a schematic view showing vertical motion of the floating body under action of waves.

Fig. 3, unlike Fig. 1, has a stronger transmission shaft 2a which can be lattice-type, tubular or similar type. This transmission shaft is used to accept stronger lateral forces caused by strong winds and waves. The transmission shaft 2a moves through a bearing 16a which is secured to the beam 9, which can be moved by use of a specially controlled mechanism. The

beam 9 moves only during the low and high tide. Thus the transmission shaft 2a does not have to be too long. The induction coil is secured to the beam by the induction coil support 15a. The beam 9 can be shifted by a mechanism attached to it or to the column 7a. The column 7a is secured to the sea-bed at one of its ends.

Fig 3a is similar to Fig.3 except the parts are shown in an axonometric perspective.

Fig. 3b shows another arrangement of the floating bodies in the direction of wave action. The number of floating bodies positioned in the direction of action of waves can be of a free choice depending on needs, and the number of the lines of the floating bodies depends on the size of waves. It is presumed that the floating bodies in the back line will be exposed to lower wave amplitudes, because the floating bodies in front lines will accept most of the energy. In this way besides electrical energy production, some parts of the coast or harbors, for example, can be protected.

Fig. 3c is a cross sectional view of Fig.3b A-a.

Fig. 4 differs from fig. 1 in following details: the floating body 1a is coupled to the transmission shaft 2b by use of a joint linkage. The transmission shaft is a gear rack which transmits vertical motion of the floating body to a mechanism 20 which converts linear motion into circular motion and transmits rotary moment to the generator for electrical energy production. This embodiment shows a schematic view of a bearing 16b which is used for proper leading of the transmission shaft 2b and to keep it coupled to its pair of mechanisms 20. The bearing 16b can be a sliding bearing, with a few pairs of roller bearings, with recirculation of the balls, for example. It can be positioned either below or over the beam 9. The best position is in front and behind the gear 18. The gear rack 2b transmits linear motion of the floating body 1a to the mechanism 20. In this embodiment a gear rack with vertical teeth is shown, although we suggest arrow-type or slant teeth in order to keep the system stable.

Operating mode: floating body 1a moves vertically under action of waves, and moves the transmission shaft 2b which is permanently in contact with the mechanism 20, which converts vertical motion of the floating body 1a into circular motion of the generator which

generates electrical energy. Detailed description of the mechanism 20 is given in the following Figure.

Fig. 5 shoes a mechanism for converting linear motion into circular motion and transmission of the rotary moment to the generator. The advantage of this solution, compared to previously described solutions is a very small number of machine parts, so the losses are minimal. For the first time one-way clutch for releasing transmission system in the transmission shaft return stroke 2b, is used. A gear 18 is secured to the beam 9a by use of one or two supports 17.

In contrast to the previously described embodiment, the electrical energy is here produced in a rotary generator 24. Incoming waves cause floating body 1a to rise and, through usage of joint 3 vertically shifts rack 2b upwardly. The vertical movement of rack 2b is converted into circular movement by means of a gear 18. Rotary motion of gear 18 is transmitted to one-way clutch 21 over shaft 19. One-way clutch 21 transmits the rotational force to one direction. Rotary motion from one-way clutch 21 is transmitted to multiplicator 22 by use of shaft 19, where the input rotation number of the shaft 19 is increased to the desired number of the projected generator 24. Multiplicator 22 can be very simple and can include one, two or more pairs of gears. Using multiplicator 22 the set number of revolutions with minimal loss can be realized. The rotational motion is transmitted from multiplicator 22 to a one-way clutch 21a by use of a shaft 19B and further by shaft 19c to flywheel 23. Flywheel 23 serves to maintain the inertia to keep generator rotating 24. Flywheel 23 can be positioned on either the left or right side of the generator 24. Rotating moment after flywheel 23 is transmitted to the generator 24 by use of a shaft and the electrical energy is produced. This is the simplest and the most efficient way of producing electrical energy so far, with small number of machine parts and minimal losses in the process of transmission of rotary moment to the generator. When the floating body reaches the upper dead center and starts moving downwards, rack 2b and the gear 18 change their direction. At that moment, clutch 21 disengages and shaft 19 rotates in the opposite direction, and shaft 19, because of inertia, keeps moving in the previous direction for a short time. In order to avoid negative impact of multiplicator 22 resistance on the rotation of generator 24 under influence of flywheel 23, a second one-way clutch 21a is used. The second one-way clutch 21a allows the generator shaft 19c to keep moving under the influence of the flywheel inertia. When floating body 1a reaches the bottom dead center and starts moving vertically upwards, the previously

described process is repeated and electrical energy is being produced. In order to reduce losses in multiplicator, generator that operates with minimal rotations should be constructed. With small number of rotations, flywheel either loses its function, or it should be extremely heavy, in which case the mechanism 20 can be arranged in such way that the shaft 19b is directly coupled to the generator shaft 24. It means that mechanism 20 would not include flywheel 23. In this case the mechanism 20 would include gear 18, shaft 19, one-way clutch 21, shaft 19a, multiplicator 22, which can be one or two pairs of gears and shaft 19b, which is coupled to generator 24. To avoid rack being extremely long and to compensate for the tides, there are three possible solutions: 1) to use a telescopic rack, i.e. a rack of a variable length. The length can be varied hydraulically, pneumatically, electromechanically, for example; 2) vertical shifting of beam 9a along columns 7a which can be realized in a few familiar and adopted ways (hydraulically, pneumatically, electromechanically, or any other combination, for example); 3) variable height of columns 7a, which can be realized in a few familiar and adopted ways (hydraulically, pneumatically, electromechanically, or any other combination, for example).

Fig. 6 shows the system for conversion of electrical energy which includes floating body 1d, which should be hermetically sealed on its upper side, with a transmission shaft 25 attached to its lower part. The transmission shaft embraces a pulley 27 and then moves upwardly towards a beam 9a with an induction coil 14a. The induction coil with a magnet 4 is attached to the flexible transmission shaft, which can be in the form of a cable, a chain or a strong rope for example. The magnet 4 is attached directly either to the transmission shaft 25 or to a rod coupled to the transmission shaft 25. After leaving the induction coil, the transmission shaft 25 moves over a smaller pulley 28a. In this arrangement the transmission shaft 25 has a weigh 26 which is used to maintain tension in transmission shaft while the pulley 27 is pivotally coupled to the column 7b. Maximal energy is generated when the magnet (permanent magnet) oscillates around the center of the induction coil 14a. To achieve oscillation around the center of the induction coil during high and low tide, the magnet 4 is moved vertically along the transmission shaft 25. The induction coil 14a, together with a beam 9b, can be moved as well. In this case, if the magnet is fixed to the transmission shaft 25, during high tide; the beam 9 moves downwards during low tide and vice versa.

Fig. 6A shows two floating bodies 1d which, over a transmission shaft 25, transmit motion to the magnet 4 in the induction coil 14a. This Figure shows a rationalized solution of placing parts of the system in space. In contrast to the previous solution, in this embodiment flexible working body moves over two pulleys 27, 27b.

Another embodiment of the energy generation system is shown, for example, in Fig. 7. In this embodiment, electrical energy is produced by floating body 1b which is much larger than those previously discussed. Floating body 1b transmits its vertical movement over transmission shaft 25 to the pulley 27d and to the mechanism 200, which transforms linear motion into circular motion by use of previously described system of shafts and one-way clutches to the rotary generator which produces electrical energy.

Displayed floating body 1b is designed to be oriented in the water so that approaching waves engage its lateral face along its length, which is longer. Orientation of floating body 1b in this fashion provides for its natural stabilization and balance. The waves rotate the floating body and engage its longer, lateral face and thus provide maximal rocking. For this reason the floating body should be three to four times longer than its width and is preferably ten and more times longer than its width. If floating body 1b is wider than the waves it encounters the efficiency of the system decreases. The floating body 1b placed in such way requires minimal forces to maintain its position, there is no natural force to rotate the floating body 1b, and the maximum amplitude provides for the most energy. To increase the amplitude of floating body 1b and decrease losses, brackets 30, 30a can be used, as shown, for example, in Fig. 7. This is desirable because of the need to increase motion amplitude and maintain the distance of floating body 1b from fixed columns. However, floating body 1a can be constructed without brackets, in which case the cables are fixed directly to the floating body 1b. In this arrangement, more force in transmission shaft 25 (a cable) and lower amplitude is obtained. When the floating body moves vertically upwards, mechanism 200 is driven through transmission shaft 25 which is secured to bracket 30a. When the floating body moves vertically downwards, mechanism 200 is driven by transmission shaft 25, which is attached to bracket 30. It has to be mentioned that the force inside transmission shaft 25 is far much stronger when the floating body shifts upwards and it is proportional to the mass of displaced water attenuated for the mass of the floating body. When the floating body moves

downwards and is driven through transmission shaft 25 secured to the bracket 30, the force is proportional to the mass of the floating body attenuated for the mass of displaced water. Weight 26 is used to keep tension in transmission shaft after the action of pulling force.

Pulley 27d of the system, shown in Fig. 7, can be placed either below or above the water surface. If pulley 27d is used above the water surface, the bracket 30d is similar to the bracket in Fig. 7B. Direct collision between bracket 30d and the pulley (27d) must be avoided.

Floating body 1b should be as long as possible, while the width depends on the length of the most frequent waves on the place where the floating body is positioned. Floating body 1b should be high enough in order to prevent waves to submerge the floating body during its rising and to obtain maximal utilization. It should be covered on the top because of rainfall. The columns are secured (fixed) to the ocean (sea) bottom.

Frame-type columns enable the placement of electrical energy production system together with all necessary equipment above floating body. Columns also enable positioning of pulley 27d, as shown, for example, in Fig. 7 which can be used to keep floating body in operating mode and at a safe distance from the columns. Notice: the force in the support of the pulley 27d is extremely strong. This happens when the floating body starts moving upwards, then, in the support of the pulley 27d, as shown, for example, in Fig. 7, two times stronger force than the force created by buoyancy of the platform in the point of action of the system for producing electrical energy, is created, so the pivot 28 and the brackets 30b, 30c have to be well dimensioned. Because of this and because of construction costs and cost of the device for electrical energy production, the optimal length of the floating body and number of units for electrical energy production placed on the platform by means of this system with flexible working body, should be discussed and found.

One way of placing the previous system in the direction of the waves is shown in Fig. 8a.

Fig. 8b is a top view of the system of Fig. 8.

Fig. 9 is another embodiment of the energy generating system of Fig. 7. The difference is in the device for electrical energy production which has inductional coils instead of a generator.

Another embodiment of the energy generating system of Fig. 4 is shown in Fig.10. The shape of the floating body 1c is a bit different, so it can be used for shorter waves.To increase the side rocking amplitude, and at the same time, the efective labour, additional mass 35 is placed in floating body 1c. The mass 65 is adapted to be shifted along the vertical axis of the floating body 1c, depending on the size of the waves. In this way it is possible to shift the center of the mass, and together with it, the lateral shifting amplitude which enables bigger output power of electrical energy from the generator. Shifting of the additional mass vertically can be performed hydraulically, pneumatically, electromechanically, combined system, for example. To prevent overturning of the floating body 1c, a system for controlling and limiting motion composed of counterbalance mass 34 is coupled to the floating body 2c and a hydraulic cylinder 33a. A supporting beam 31h on the floating body 1c represses transmission shaft 2c which is coupled to the pinion gear 18 of the conversion mechanism 20.

Fig. 11, 11a, 11b, 11c, 11d, 11e, 11f and 11g show another embodiment of the energy generating system of Fig. 4.

Fig. 11 shows a large floating body 1e which has a set of lateral energy generating systems on both longer sides of the floating body. Fig. 11d is a top view of the large floating body 2e and Fig.11b is a lateral view of large floating body 1e.

Fig.11a and 11c show the coupling of floating body 2e and the energy generating system by use of a transmission shaft 2c. To increase the amplitude of shifting of the floating body 2e, a bracket 30g is attached. The bracket 30g is adapted to rest upon profiled cylinders 32a, 32b as shown in Fig 11c of Fig. 11a. Generating lines of profiled cylinders 32a, 32b are arc-shaped, as shown in Fig.11a. In this way selfalignment of the floating body 1e is obtained. The profiled cylinders 32a, 32b can have a variable diameters, but it is important not to cross the bending line of the bracket 30g. The profiled cylinders 32a, 32b permanently rest on the bracket 30g so the impact load could be avoided. This can be accomplished by the system of springs in the transmission shaft 2c, for example. The bracket 30g, by means of profiled cylinders 32a, 32b transmits linear motion to the transmission shaft 2c, and bearings secured to the column 71a provide proper resting of the transmission shaft 2c on the pinion

gear 18 which trasforms linear motion of the transmission shaft 2c into circular motion of the mechanism for conversion.The floating body 1e includes at least four lateral support arms 36a, 36b which are used to prevent the bracket 30g from touching the transmission shaft 2c outside profiled cylinders 32a, 32b and to prevent the bracket from crossing the bending line. The support arms 36a, 36b should be constructed in such way to keep the floating body 1e in the operating position during rough sea conditions. Fig. 11c shows a mutual position of the cylinders 32a, 32b with respect to bracket 30g.

Fig. 11e shows that leading of the transmission shaft 2c is performed between parts 71a and 71b of the supporting column 70 which is fixed to the bottom of the ocean (sea) on the one side.

Fig. 11f is a perspective view of the system for running the generator 24 for electrical energy production which enables converting vertical motion of the floating body 1e in both directions (upwards and downwards) into useful rotation moment for running of the generator 24.

Fig. 11g is a detailed layout of the device. As the wave aproaches and the floating body 1e rises, the transmission shaft 2c shifts upwards, rotates a gear 18 in one direction. The achieved rotation moment is transmitted to the first one-way clutch 21b and further to the multiplicator 22 and further to the shaft 19b and the second one-way clutch 21a and to the generator 24. The one-way clutch 21b is realised and it does not transmit the rotating moment with this motion of the transmission shaft 2c. When the transmission shaft 2c starts moving downwards the gear 18 starts rotateing in the opposite direction. At this moment the one-way clutch 21b is released, and accepts the turning moment and transmits it to the multilicator 22 and further to the generator 24. To provide permanent rotation in the same direction at the entrance of the multiplicator 22 additional set of gears 18a, 18b,18c is used. A hollow shaft 18e in this case includes external gearing and a one-way clutch 21b. The hollow shaft 18e is fixed to the shaft .

Fig. 12, 12a, 12b, 12c and 12d is another embodiment of the energy generating system of Fig.4.

Fig.12 shows a portion of the floating body 1f with a transmission shaft 2d attached to it. Contrary to the previous versions, the motion of the floating working body 1f is transmitted to the transmission shaft 2d over arc prisms and the cylinder 60. Electrical energy is produced by the motion of the rack 2d. This system has already been described.

A direct connection of the rack 2d and the floating body 1f is shown in Fig. 12a. A support 51, together with the cylinders, that are in shape of a shackle, provides resting of the transmission shaft 2d on the gear 18. In this case, the support 51, which rotates around the same axis as the gear 18, includes two cylinders 52 which are coupled to the transmission shaft 2d. To prevent lateral movement of the transmission shaft 2d the transmission shaft 2d should be brought into bearing 16c that is secured to the column 700. The bearing 16c accepts lateral forces and enables motion of the transmission shaft 2d towards the column 700 and from the column 700. Selfalignment is accomplished by use of arc prisms 61, 61a as shown in details A and B of Fig. 12c and 12d.

Fig.12a is a hydraulic cylindr 703 in cross section. The height of the column 700 can be varied to account for tidal changes by use of a hydraulic cylinder. In this way the transmission shaft 2d does not have to be too long. The energy generating system has been previously described.

Fig. 13 shows a new approach to the utilization of wave energy. In this version the production of electrical energy from wave motion can be accomplished without any columns fixed to the sea-bed. One unit of this system includes two side floating bodies 100a, 100b and a central floating body 100. All floating bodies should be hermetically sealed. Floating body 100 should also be hermetically sealed, but free motion of the transmission shaft 2e with respect to surface of the floating body 100 should be allowed; this can be realized by a flexible membrane. At the bottom of the floating body 100 is a transmission shaft 2a support. Axis of two lateral cylindrical supports passes through the axis of the floating body support 100 which keeps the central floating body 100 in the center of the system. Transmission shaft 2e transmits motion to the upper system for electrical energy production, as it has already been described. The side floating bodies 100a, 100b are also, at their lowest point below the point of baricentar of displacement, coupled to lower construction of the system, a connecting support, for example, over a hollow overhang, so they can twist with respect to the lower construction. The side floating bodies 100a, 100b can consist either of individual units, as shown in Fig. 13, or one continual unit. Floating bodies 100a, 100b are coupled to the coupling support 65 over the lower construction by a hollow shaft. Since the wavelength can vary and since the desirable distance between lateral floats should be equal to the wavelength, the spacing of the floating bodies 100a, 100b can be varied by use of a device for extending and retracting side bodies, which is introduced in this embodiment. This can be

done hydraulically, pneumatically, electromechanically, or combined system, for example. In the middle of the coupling support 65 two guides 66 should be placed. Between the guides 65, a hollow overhang of the central floating body would move. The clearance in this point should be a little bit wider to make jamming impossible although alignment between lower constructions will be done automatically by contact between the gear rack and the gear. Floating bodies 100a, 100b should be as light as possible and the coupling support 65 should have as weak resistance to vertical motion through water as possible. Coupling support 65 should extend into arc-type support 64 as shown in Fig.13, or a similar lattice-type construction, for example, to which upper system for electrical energy production would be secured, which can include a rotating generator or an induction coil as it has previously been described. The system in this arrangement is preferably longer than wider, as we have previously described, so the system could take the best position against the waves and to prevent the waves of twisting the system. The system is fixed to the sea-bed by use of an anchor, a massive body. In this arrangement the system for electrical energy does not damage sea-bed. In the future, when wireless energy transmission has been invented, units like this one could be positioned in different regions off the coast where the waves are high. The efficiency of this system should be higher because of the motion of the central floating body and the useful motion of the upper system.

Fig. 13 shows a portion of the system which can consist of as many individual units as we wish. Generator of mechanism for conversion 20 can be coupled to one or more floating bodies 100 over a transmission shaft 2e.

Fig. 13a shows central floating body 100 in its upper position.

Fig. 13b shows central floating body 100 in its lower position.

Fig. 13c shows possible positioning of the energy generating system in space while Fig. 13d shows a top view of one arrangement like this.

Fig.14 shows the system for electrical energy production placed on this version of the system for producing electrical energy from wave motion of Fig. 1

It has to be mentioned that high quality one-way clutches 21, 21a, which instantly accept rotating moment are available on the market. In case when, because of low angle speed of the pulley 31 and the gear 18, one-way clutch 21, 21a does not accept rotating

moment instantly, a multiplicator or a spring system can follow the pulley 31 or gear 18 in order to avoid this one-way clutch defect.

CLAIMS

1. A system for converting wave motion into electrical energy comprising: columns (7, 700) fixed to the sea or ocean bed, wherein the floating body (1a, 1b, 1c, 1d, 1e, 100, 100a, 100b) is included; the floating body (1a, 1b, 1c, 1d, 1e, 100, 100a, 100b) is on the one side inflexibly coupled either to a fixed transmission shaft (2, 2a, 2b, 2c, 2d, 2e), or to an inflexible transmission shaft (25), and the second end of transmission shaft (2, 2a, 2b, 2c, 2d, 2e) is coupled either to a magnet (4) of the induction coil (14, 14a) or to a mechanism (20) for conversion which is fixed to an inflexible beam (9); profiled cylinders (32a 32b) encircle bracket (30g), and profiled prisms (61, 61a) encircle cylinder (62); mechanism for conversion (20, 200) with respect to the magnet (4) which is, inside induction (14a), coupled to the floating body (100) by use of a transmission shaft (2e); floating bodies (100a, 100b) are coupled to the support (65) and a mechanism (33b) for alignment of the distance between floating bodies (100a, 100b).

2. The system for converting wave motion into electrical energy as claimed in claim 1, wherein the floating body 1a, 1b, 1c, 1d, 1e,100, 100a, 100b is connected, by use of a joint linkage, to point A and the point of baricentar of water displacement.

3. The system for converting wave motion into electrical energy as claimed in any of claim 1 to 2, wherein the floating bodies (1a, 1b, 1c, 1d, 1e, 100, 100a, 100b) are hermetical, hollow and/or filled with some lightweight material.

4. The system for converting wave motion into electrical energy as claimed in any of claim 1 to 3, wherein the floating body 1c includes additional flexible mass (35).

5. The system for converting wave motion into electrical energy as claimed in any of claims 1to 3, wherein the floating body (1a, 1b, 1c, 1d, 1e, 100, 100a, 100b) is positioned on the rim with pneumatic balloons.

6. The system for converting wave motion into electrical energy as claimed in any of claims 1 to 5, wherein the induction coil (14,14a) is, together with the magnet (4), directly coupled to the floating body (1a, 1b, 1d) above the water surface.

7. The system for converting wave motion into electrical energy as claimed in claim 1, wherein the beam (9) is at its ends coupled to the columns (7) by use of a sliding linkage.

8. The system for converting wave motion into electrical energy as claimed in claim 1, wherein the column (700), having an inflexible part (702), on the one side is fixed to the sea-bed and on the other side is, by means of a sliding linkage, coupled to a flexible part (701) having an operating mechanism (703).

9. The system for converting wave motion into electrical energy as claimed in claim 1, wherein the mechanism (20) is fixed to the beam (9, 9a, 9b, 9c) and includes an operating unit (18) which is coupled to one end of the shaft (19), and the other end of the shaft (19) is linked to a one-way clutch (21), which is coupled to a shaft (19a), and the shaft (19a) is coupled to a multiplicator (22), which is coupled to one end of the shaft (19b), and the other end of the shaft (19b) is coupled to the one-way clutch (21), which is coupled to one end of the shaft (19c) and the other end of the shaft (19c) is coupled to a flywheel (23),which is coupled to the generator (24).

10. The system for converting wave motion into electrical energy as claimed in claim 1, wherein the mechanism (20) is fixed to the beam (9, 9a, 9b, 9c) and includes an operating unit (18), fixed to the one side of the shaft (19), and the other side of the shaft (19) is coupled to the one-way clutch (21), which is coupled to the shaft (19a) and the shaft (19a) is coupled to the multiplicator (22), to which a generator (24), with or without a flywheel, is coupled.

11. The system for converting wave motion into electrical energy as claimed in any of claims 1 to 10, wherein one end of the transmission shaft (25) fixed to the floating body (1b, 1d), where the transmission shaft (25) encircles pulley (27) that is below water surface.

12. The system for converting wave motion into electrical energy as claimed in claim 1, wherein the floating body (1b, 1c, 1d, 1e), is laterally, by use of fixed brackets (30, 30a, 30b, 30c, 30e, 30f, 30g), coupled to the transmission shaft (2c, 25).

13. The system for producing electrical energy as claimed in claim 1, wherein the generating line on the cylinder (32a, 32b) is in shape of an arc.

14. The system for converting wave motion into electrical energy as claimed in any of claims 1 to 2, wherein the longer side of the floating body (1b 1c, 1e, 1f, 100, 100a, 100b) is positioned vertically with respect to direction of wave action.

15. The system for converting wave motion into electrical energy as claimed in claim 1, wherein the floating body (100) is coupled to the guides (66) by use of sliding linkage, while the guides (66) are fixed to connecting support (65).

16 The method for converting wave motion into electrical energy as claimed in any of claims 1 to 15, wherein the construction of floating bodies (1a, 1b, 1c, 1d, 1e, 100, 100a, 100b) is positioned on the water surface and shifted by action of aquatic waves; wherein the motion of floating bodies (1a, 1b, 1c, 1d, 1e, 100, 100a, 100b) is transmitted either to the magnet (4) by means of a transmission shaft (2a, 2b, 2c, 2e), positioned inside the induction coil (14, 14a), or to the mechanism (20, 200) for conversion of linear motion into circular motion and its transmission by use of a shaft (19), one-way clutch (21), a shaft (19a), to the multiplicator (22), and then by use shaft (19b), one-way clutch (21a), shaft of the generator (19c), flywheel (23) and generator.