Abstract Title: Driving an electricity generator using the kinetic, gravitational or air pressure forces present in the flow of vehicular or pedestrian traffic or sea waves

A device for obtaining power to drive an electricity generator from the kinetic, gravitational or air pressure forces present in the flow of vehicular or pedestrian traffic or the ebb and flow of sea waves, comprises means such as a plate, ramp or air input assembly for absorbing kinetic, gravitational or air pressure energy present in these circumstances. In one embodiment, fig.1, a pressure plate C is pressed down by passing vehicle wheels and drives down a large-area hydraulic piston D forcing a smaller piston G to travel along a cylinder H and to drive an output shaft N by means of meshing gear teeth. Alternatively (figs.5a-c), the smaller piston (C) compresses air in a cylinder (E) having a high pressure outlet (G). In a mechanical variant, fig.3, eg a traffic calming speed hump, passing vehicles push down ramps A,B forcing a rod C to rotate an output shaft J via a one-way clutch D. The energy may be stored in a spiral coil spring (D, fig.7). In another arrangement, air pressure in front of approaching vehicles is diverted down vents (A, fig.6) in the road surface and the air is channelled past a turbine or impeller (B), assisted by the reduced pressure behind departing vehicles.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 2007.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.
Diagram page 2 of 4

Figure 3

Vehicle direction of travel

Figure 4

Direction of travel
Generator drive device

It is well known to obtain power to drive electricity generators driven by alternative energy sources such as wind, hydro and wave. These are normally restricted to areas where these natural power sources are available and are typically not present in built up urban areas. Most of these urban areas do usually however have many roads with a constant and high level of vehicular traffic flow that can be utilised as a source of power.

Statement of invention:

To meet this need this invention proposes several devices for utilising kinetic, gravitational and air pressure forces present in the flow of vehicular traffic in the form of, but not restricted to a pressure plate hydraulic drive, mechanical angled ramp or air input assembly placed in or adjacent to the traffic path for the purpose of collecting or absorbing energy created by the flow of traffic past the devices.

This invention concerns apparatus for electricity generation using forces present in traffic flow such as kinetic, gravitational and air pressure forces primarily. It is particularly concerned with providing mechanisms to capture the high energy short duration impulse events created by passing vehicular traffic and convert these into lower energy events of longer duration to enable that power source to be used to drive electric generators or other workload applications. It is to be noted that although not primarily designed for those purposes it is believed it would also be possible to use the pressure plate variants of this device in a wave or tidal power generator.

Advantages

These devices absorb and utilise naturally occurring kinetic, gravitational and air pressure forces generated by road traffic vehicles. These forces are currently unused with air pressure forces dispersed into the atmosphere and gravitational forces dispersed unused through the road surface.

This method of electricity generation is in itself virtually pollution free as it uses no fuel itself and would cause little or no addition fuel to be consumed by the vehicles that input energy to the devices. This is especially true in the pressure plate and air induction variants.

To eliminate any engine loading whatsoever, the mechanical variants could be placed on suitable road down slopes where they would use only the vehicles weight and momentum to operate without utilising any of the vehicle engine drive power.

It is also estimated that even on flat stretches of road the due to gravitational, kinetic and air pressure forces present any additional engine loading and fuel consumption overhead would be minimal.
Air induction variants would be suitable for high speed operation such as is present on motorways. This variant presents no vehicle resistance at all due to the fact that there is no physical impediment to device momentum.

No additional pollution factor as device uses existing energy produced by vehicular or pedestrian traffic.

Devices have low physical profile to enable vehicles to pass over with little or no obstruction. An added advantage of this is very low environmental visual impact compared to wind turbines for instance.

The devices represent a way of obtaining energy for the generation of electricity from a significant new alternative and currently unused source of energy.

Devices are scalable and can be adapted to meet differing traffic conditions and energy needs.

Multiple units along highways can supply power for large areas.

Smaller installation numbers of units on access roads can be used to generate supplies for individual campuses, for example hospitals and universities.

Road ramp variation be used on roads in place of speed bumps for traffic calming as well as power generation.

Devices can be used for different traffic types such as, but not restricted to, road vehicles, pedestrians and sea waves.

Preferably, but not restricted to, the use of pivoting inclined ramps to enable the capture of both Kinetic energy present due to vehicle forward momentum and gravitational forces present due to vehicle weight and momentum.

Preferably, device has method storing the mechanical impulse energy such as, but not restricted to, coiled spring, flywheel, compressed air devices or electrical batteries such that this will allow controlled release of energy directly or to electrical generators.

Preferably, there is at least one ratchet or one-way clutch device incorporated in ramp and pressure plate gear drive variants to facilitate instant resetting of devices between input events and one to facilitate resetting of energy storage sub-mechanisms.

Preferably the energy storage sub-mechanism component of this device incorporates a governor type mechanism where necessary to enable a slower release of the energy that was stored due to impulse events caused by traffic flow over the device though it is noted that the loading from generator and gearing system is likely to present a natural significant output governing effect.
Preferably device ramp plate or pressure plate variants are incorporated in the form of a low profile road mat or plate type structure to enable vehicles to pass over with minimum effect on the vehicle and allows for installation and maintenance without compromising highway surface.

All the device example variants disclosed can be also installed in recesses in road surfaces. While this is possible it is assumed that the 'surface mat' design will be preferred on existing roads to minimise disruption and the road recess installations could be more easily incorporated in new highway build schemes.

Examples of these devices will now be described by referring to the following accompanying drawings (Please note - figures are drawn for clarity of explanation and not to scale):

Figure 1 shows an example of a hydraulic pressure plate variation using a hydraulic system to power a rotating drive shaft. This variant is suitable for low to medium speed traffic.

Figure 2 as fig 1 showing example 1 in an activated position as wheels drive over it.

Figure 3 shows detail of a mechanical angled ramp plate assembly variant which is suitable for slow or medium speed traffic believed to be up to about 30mph. It is also suitable for use in place of traffic calming devices such as speed humps.

Figure 4 refers to ramp plate variant as described in figure 3 and shows that mechanism in the activated position.

Figure 5 shows an example of a hydraulic pressure plate variation utilising a compressed air system as an energy storage and shock absorber mechanism.

Figure 6 shows an example of the usage of air pressure created from vehicle movement used to drive an air turbine device variant.

Figure 7 shows drive chain and components from angled ramp plate example 2 device to generator utilising a coiled flat spring as an energy storage device and shock absorber system.

These devices utilise any combination of kinetic, gravitational and air-pressure energy collected from flowing traffic by means of a mechanisms to collects energy from transient high energy short duration events such present in the flow of vehicular traffic or sea waves. In this disclosure, this energy collection is made possible through the effect of cars or waves passing over ramps, hydraulic pressure plate or air induction mechanisms or any combination thereof. The resulting force is delivered to a drive shaft.
or other suitable transport mechanism such as hydraulic pressure lines to a generator via suitable gearing and a shock absorbing and power storage devices such as mechanical coiled springs or compressed air systems. In the ramp plate and pressure plate variants a one way shaft clutch, coupling or ratchet mechanisms would be utilised to allow the energy collection mechanism to reset between power input impulses while the rest of the drive chain continues to drive. Air induction variants would not require the one-way shaft coupler.

Detailed description of variants:

**Example 1** – Hydraulic pressure plate shaft driven electricity generator

Referring to **Figure 1** - This description will use passing vehicular traffic gravitational forces as the main source of drive input but there will be some kinetic energy also absorbed by approach ramp plates. It should be also noted that this variant will function with other type of passing mass (such as sea waves or pedestrians for example) and that this example utilises mainly the gravitational force caused by the weight of the object on the pressure plate rather than kinetic impact forces.

In this example which uses road traffic as the power source, a vehicle approaches from either direction on either a highway surface if device is recessed into surface or as shown in this example, via a road mat surface (A) after ascending mat angled ramp edge. Vehicle then passes over ramp plate (B) and on to pressure plate (C). Pressure plate (C) will be approximately only 80mm above road level (A) to minimise influence on car travel and to provide adequate ground clearance for the vehicle. It will also not act like a solid ramp as it will move down presenting a more cushioned effect to the vehicle suspension.

Weight of vehicle pushes down through wheels onto on plate (C) driving down large surface area hydraulic piston (D) and forcing hydraulic fluid (F) contained in hydraulic reservoir (E) out of one or more small outlet cylinder hydraulic pipes (H). Plate (C) will compress piston return spring (R) and will stop downward travel when it reaches stop blocks (P) at which point upper surface of (C) will be level with road or ramp mat surface.

*Fluid being driven through cylinder (H) will force a smaller surface two way piston (G) to travel ahead of fluid.* Two way piston (G) will travel into receiving cylinder (J) and compress spring (K). When piston (G) is moving in this drive direction it will rotate drive shaft (N) in this example, by a line of gear teeth along its length engaging with drive gear (L) mounted on one way drive clutch (M). The length of the drive piston movement is to be such that drive shaft and gear will be driven through several revolutions with each piston stroke travel.

When vehicle wheel clears ramp plates (B) the compressed return springs (R) and (K) will move pistons (D) and (G) back to their start positions. This will cause the hydraulic fluid to return to reservoir (E) and also move pressure plate (C) back up to start position.
Piston (G) will be able to move in this return direction without affecting drive shaft (N) continued forward rotation due to the use of one way clutch (M) now allowing the engaged drive gear (L) to be driven in the freewheel return direction. Drive shaft (N) will continue to rotate and deliver drive to an appropriate electricity generation system via any (as required) gearing mechanisms or drive storage systems while the pistons are at their start positions awaiting next impulse event.

Figure 2 shows the pressure plate example as fig 1 but is now showing the pressure plate in an activated position as wheels drives over it. At this point, wheels are on pressure plate (C) which is now level with road surface. Large piston (D) has been driven down compressing main return spring (R) and is on stop blocks (P). Hydraulic fluid forced out of reservoir through cylinder (H) has pushed small piston (G) along cylinder (H) thereby rotating drive shaft gear (L), one way clutch (M) and drive shaft (N). Other end of small piston (G) has travelled further into cylinder (J) and compressed return spring (K) which is now ready to return piston (G) to start position once weight has moved off pressure plate (C). Following output calculation example based on piston (G) length being such that it travels far enough to rotate drive gear through 4 revolutions with each drive stroke. There are two drive (impulse) strokes generated by each vehicle – one from each pair of wheels. Cars are passing at the rate of one every three seconds which equates to 20 cars per minute and therefore 40 impulses per minute. So 40 impulses x 4 drive gear revolutions per impulse = 160 drive gear revolutions per minute. Utilising a 10:1 gearbox to drive generator, 1600 rpm is achieved at the generator. This mechanism would also function with the ebb and flow of weight of sea waves moving over it in both directions. It is envisaged in a marine application the ramp plate would be enclosed in a waterproof flexible shroud or equivalent to protect it from marine contamination.

Example 2 – referring to diagram figures 3 and 4.

Fig 3 shows an angled mechanical ramp plate example of this proposal which is suitable for slow or medium speed traffic and is also suitable for use as traffic calming speed humps. This devices variant utilises both kinetic energy and gravitational weight.

Diagram shows assembly incorporated in a solid mat (E) such that whole assembly can be placed on an existing road surface but assembly can also be recessed into a road surface. This second method might be more acceptable when incorporated into new road construction. Vehicles approach from either direction on highway surface (F), drive up small ramps (A or B) which have a height of approx 80mm. Vehicle will not reach that height as ramp plates will immediately be pushed down by vehicle axle weight. Ramp plates are hinged at lower edges. Ramps travelling downward will force fulcrum rod (C) to rotate downwards which in turn will rotate shaft (J) via a one-way drive clutch (D).
Drive shaft (J) will be connected to a generator, induction coil or other workload via a suitable gearing and energy storage mechanisms as required. Hinge flap (G) is present to ensure that vehicles approaching upper plate from that direction will meet a downward pointing leading edge for ramp (A) as opposed to an upward pointing edge which may result in damage to wheels.

**Figure 4** shows angled ramp plate device in activated position. Plates (A) and (B) are in horizontal position level with mat surface with plate (B) sliding under plate (A). Fulcrum (C) is also in fully rotated horizontal position against stop block. (When wheels clear device the plates and fulcrum will rotate in opposite direction back to start point due to spring return mechanisms (not shown). Drive shaft (J) will continue rotating due to over –spinning enabled by use of one-way shaft drive clutch (D) used between fulcrum rod (C) and drive shaft (J).

**Figure 5** shows a third example variant which utilises a hydraulic pressure plate for input as in example 1 but uses an air compression system for shock absorption and energy storage instead of the coiled spring storage shown in figure 7.  
**Figure 5a, 5b and 5c** shows device conditions before, during and after the weight has passed. Hinged ramp approach plates not drawn but assumed to be incorporated.

Weight moving over a plate (A) causes depression of piston (B) to push hydraulic fluid against 2-way piston cylinder (C), compresses main return spring (R) until halted by stop blocks P at which time it is level with the road or mat surface. The two way smaller cylinder in (C) is driven into and compressed air in cylinder (E) and stretches return springs (F). By this means air will be forced into cylinder (E) past one way flap (H) and compresses air in the rear of chamber (E). One way air flaps (H) will open in this direction to allow the addition of air as shown in fig 5b.

The return springs (F) will return 2-way piston to start point as soon as passing weight moves off pressure plate (A) but compressed air in cylinder (E) will be contained within it by one way air flaps (H) as in figure 5c. Pressurised air is allowed to escape through high pressure nozzle and hose outlet (G) which will drive a rotor or turbine for electric generator either directly or via a gearbox. One way air valve (H) maintains air outlet pressure until compressed air reservoir is fully depleted by air exiting through high pressure outlet (G) but compressed air will be continually added as vehicles or waves pass over plate (A).

Tube (G) can be of a great enough length to connect to a turbine alternator/generator to the side of the highway on road installations and on dry land for sea wave installations.

Each generator drive shaft may be fitted with a plurality of rotor blades along the length to allow generator to be driven by multiple devices as required. The advantage of this is of course that a single larger generator can be used rather than multiple smaller ones.

**Figure 6** – diagram shows a fourth device example with the usage of air pressure from vehicles utilised to drive an air turbine variant. This diagram shows vehicle travelling from right to left.

Air pressure that is naturally built up in front of moving vehicles diverted down into narrow angled vents (A) in road or ramp mat surface. This air is channelled and
directed past a turbine or impeller (B) which will drive an alternator or generator either directly or via an indirect drive system. Cars passing on the far side of device will create a vacuum which will draw air out of the channel through the angled slots (C). This will increase throughput of air past the turbine or impellers.

**Figure 7**

This describes an example component chain for the angled road ramp plate variation of this invention as shown in figures 3 and 4.

From the output drive shaft to the generator the following elements may be present also as in the first example, the hydraulic pressure plate gear driven variant, although the need for a flywheel, energy storage coil spring or gearbox is greatly reduced in the hydraulic gear driven pressure plate version.

A vehicle drives over angled road ramp plate (A) pushing it down which in turn pushes down on fulcrum rod (B1) which rotates attached one way clutch or ratchet drive (B2) and consequently rotates drive shaft (C). Drive shaft rotation adds tension to spiral coil spring (D). After vehicle wheels have cleared the ramp, it is immediately returned to upright angled start position by reset springs (not shown) in this example and is then ready for next impulse input event.

This reset movement is made possible because drive shaft is able to rotate in reverse freewheel direction due to use of one way drive clutch shaft coupler or ratchet mechanism (B2).

It is estimated that the fulcrum rod will travel through 1/5th of a revolution with each impulse but due to the high impact nature of input from ramp plates, the drive shaft (C) will be over-spun due to the additional momentum that will be stored in the flywheel and the use of a one way drive clutch or ratchet mechanism. It is estimated that drive shaft will rotate through at least one complete revolution for every impulse. The revolution of drive shaft (C) will add tension to spiral flat spring (G).

A mechanism such as a spring loaded detent pawl or governor mechanism (F) engaging a toothed gear (E) on coil spring shaft will prevents coil clock spring unwinding.

When sufficient energy has been collected in coil spring from wheels that have passed over ramp and drive force level is attained, the outer leaf of spiral spring (G) will begin to rotate and start driving generator drive wheel (J) via stud (H) and gearbox as required.

Subsequent vehicles passing over ramp continue to add tension to coil spring which smoothes impulse drive to generator and also acts a reservoir of stored energy that enables the generator to continue to be driven for short periods when there are gaps in the traffic flowing over the road ramp plates.

Component specification such as angle and height of ramp along with other optional components such as, but not limited to, flywheel, coil spring gearbox can be varied to suit traffic type and speeds on particular highways to achieve maximum efficiency. Design is such that drive shaft (D) will be rotated 72 degrees to horizontal position and it is predicted that the force that is absorbed from the moving vehicle striking the ramp
plate will be sufficient to over spin the drive shaft by use of a flywheel such that the
drive shaft will travel through at least 360 degrees which is a ratio of 5:1.

This rotation could be transferred directly to generator or gearbox or indirectly via a
spiral energy storage spring (G). As soon as vehicle wheels no longer are forcing
ramp plate downwards, return springs will immediately reset plate to angled start
position awaiting arrival of next set of vehicle wheels. This is made possible by one
way drive clutch mechanism between fulcrum rod (C) and drive shaft (D) will allow
the fulcrum rod to rotate backwards under spring tension (not shown) and return to
start position while the drive shaft will be able to continue its rotation.

Assuming that a storage spring (G) is used as in this example the flywheel drive shaft
would add tension to the coil spring (G) at the centre and a detent pawl (F) and
gearwheel (E) on the drive shaft could be used to assist in preventing the spring
unwinding at the centre. This spring would also act as a shock absorbing system
between the ramp plate drive and the generator drive. When sufficient coil spring
tension is obtained the outer end of the coil spring will start to drive generator or
gearbox by turning drive wheel (J) via stud (H).

It is expected that although the power stored in the spring will be substantial,
because of the resistance presented by the generator itself and any gear train on the
output side of the spring the addition of any other governor mechanism would only be
required if there is a danger of the spring delivering in excess of the generator
maximum RPM design limit.

Assuming average nominal traffic flow is 20 cars per minute, this equates to 40 axle
impulses per minute. At a 5:1 over-spin ratio due to the flywheel effect, that would
equate to 40 revolutions per minute of the drive shaft. If this drive was then put
through a gearbox of 25:1 ratio a generator drive speed of 1000 rpm would be
achieved. If traffic flow was a realistically achievable 30 cars per minute, then a
generator speed of 1200 rpm would be achieved. Vehicles with more than two axles
such as trucks and coaches would raise input force and rpm levels even further due
to increased energy input into flywheel over-spin effect.
Claims:

1 - A device for utilising kinetic, gravitational and air pressure forces present in the flow of vehicular traffic in the form of, but not restricted to a pressure plate hydraulic drive, mechanical angled ramp or air input assembly placed in or adjacent to the traffic path for the purpose of collecting or absorbing energy created by the flow of traffic past the device.

2 - a energy collection device according to claim 1 that transfers input energy from these sources to any electricity induction system, generator drive input or any energy storage systems of these energy sources by, but not restricted to, a rotating drive shaft, air compression system or hydraulic system.

3 - a energy collection device according to claim 1 that utilises a means of accumulating and storing the energy if required such as, but not restricted to, a heavy duty spring or air compression system and governed by an output regulator system where appropriate to meet the requirement of a controlled release of the accumulated energy to provide drive force to an electricity induction system or generator via any appropriate gearing mechanism.

4 - a energy collection device according to claim 1 which has variants to allow suitable functionality at slow, medium and high speed traffic flow specifically angled ramp plates for lower vehicle speeds, pressure plates for medium to high speed and air induction devices for low to high speed traffic.

5 - A generator input device according to claim 1 specifically regarding ramp plate and pressure plate hydraulic driven drive gear variants which incorporates one or more one-way drive mechanisms anywhere in the drive chain that allows energy transference from the drive shaft to an energy accumulating device or directly to the generator or induction system and then allows the drive input device to return back to start position to be ready to capture energy from next impulse event while allowing the drive train continues to move in the drive direction.

6 - a device according to claim 1 where a pressure plate hydraulic system incorporates a piston of a large surface area and a short stroke of travel on the pressure plate input side which moves hydraulic fluid into narrower surface area piston cylinders on the output side thus creating a longer stroke on the output side from the volume of fluid moved by the input piston.

7 - a device according to claim 6 that utilises a long stroke cylinder piston on the output side whose shaft have drive teeth or any other suitable mechanism that engage with a drive gear on an output drive shaft such as to be able rotate the drive gear through several revolutions due to relative length of piston stroke in relation to circumference of drive gear.

8 – Regarding claims 6 and 7, specifically the use in tidal and sea wave variants, the use of a hydraulic pressure plate and piston stroke travel magnification effect described in claims 6 and 7.

9 – a device according to claim 1 that incorporates one or more approach ramps leading to or away from device.
10. a device according to claim 1, with specific regard to the mechanical ramp plate variants, the usage of upwardly angled ramp plate assemblies that can be used in slow traffic zones which could also function as speed ramp traffic calming devices.

11. a device according to claim 9 which uses one or more smaller downward angled overlapping hinged flaps along the higher edge of the upper ramp plates to allow vehicles to pass over upper edge without damage when travelling in a direction towards that edge.

12. a device according to claim 1, specifically referring to air movement and pressure devices which utilises a method of air intake and outlet such as slots, fans or turbine mechanism that react to air movement forces caused by air pressure build up when vehicles approach at speed and the vacuum suction effect present when vehicles have passed.

13. A device according to claim 12 which utilises methods of channelling the air intake produced by these forces and directing the airflow to drive turbines attached to electricity generators, turbines or direct electricity induction devices.

14. for devices as in claim 1, a housing for mechanical input and transmission elements of devices in the form of a low profile large mat structure or similar which can be made of any suitable material capable of withstanding the forces exerted on it by vehicular traffic or sea water.

15. for housing in claim 14, the use angled edge profiles ramp structures to minimise shock of vehicles approaching the devices disclosed in claim 1.

16. A generator power input variant according to claim 1 where traffic flows past, but not restricted to, a pivoting angled plate or ramp or air movement device causing transference of energy to a drive shaft or turbine, hydraulic air compression or direct electricity induction system or which in turn provides drive input to a generator, direct induction system, turbine or performs any other workload directly or via any connecting drive mechanisms.
Application No: GB0812745.8  Examiner: John Twin
Claims searched: 1 to 16  Date of search: 3 November 2008

**Patents Act 1977: Search Report under Section 17**

**Documents considered to be relevant:**

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**Field of Search:**

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

- Worldwide search of patent documents classified in the following areas of the IPC: F03B; F03G; H02K
- The following online and other databases have been used in the preparation of this search report: EPDOC, WPI

**International Classification:**

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