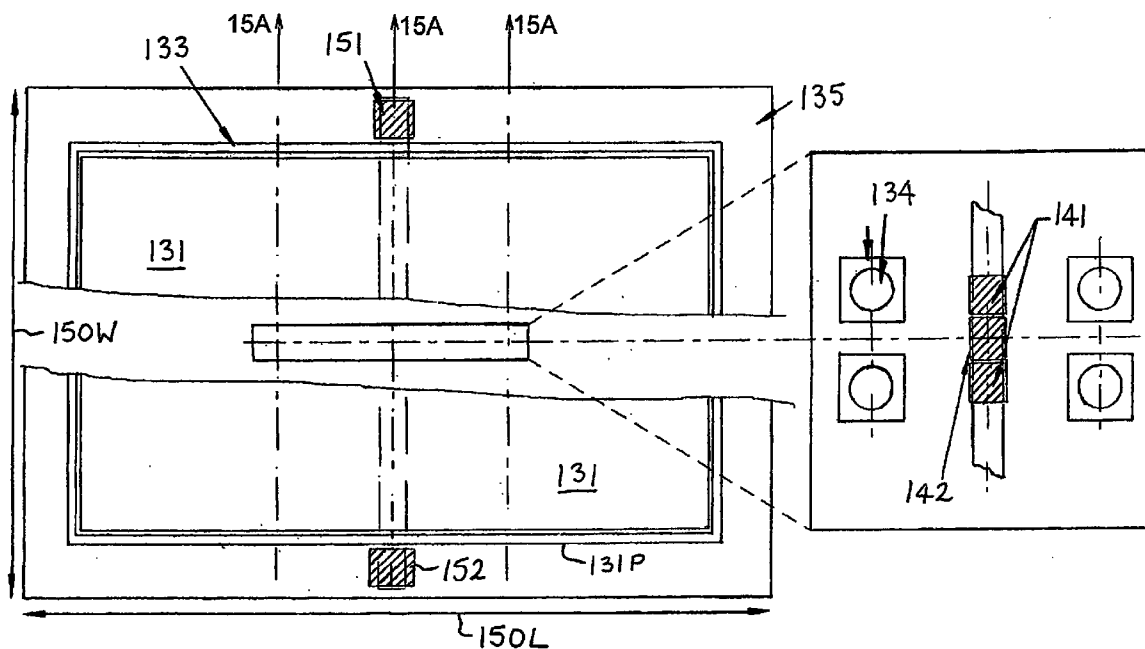


Jul. 6, 2006



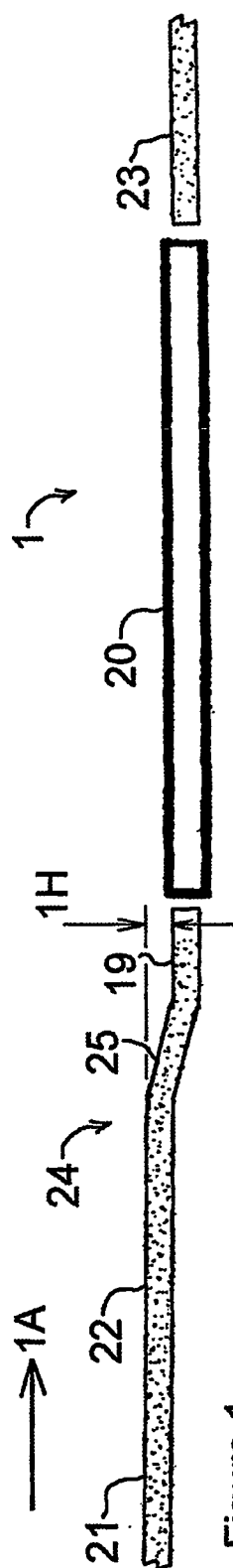


Figure 1

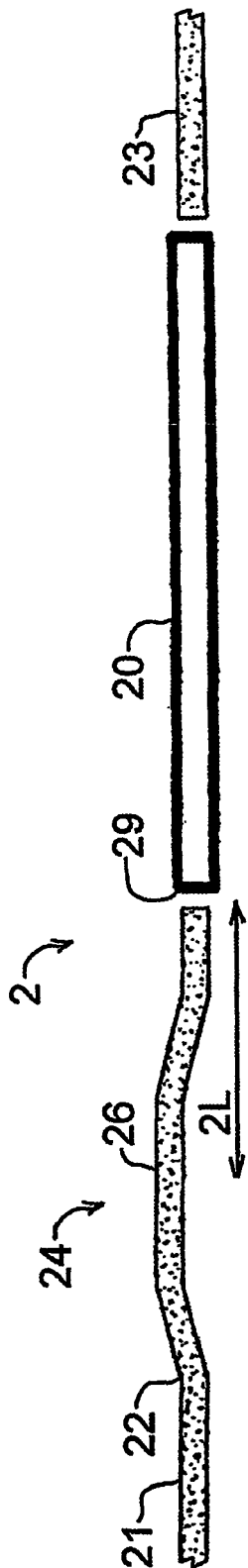


Figure 2

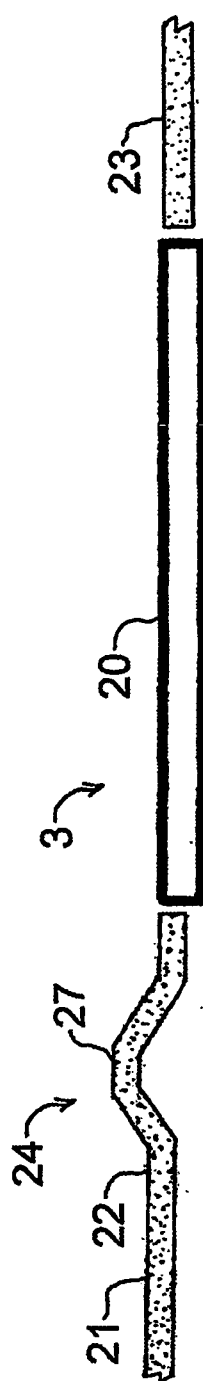


Figure 3

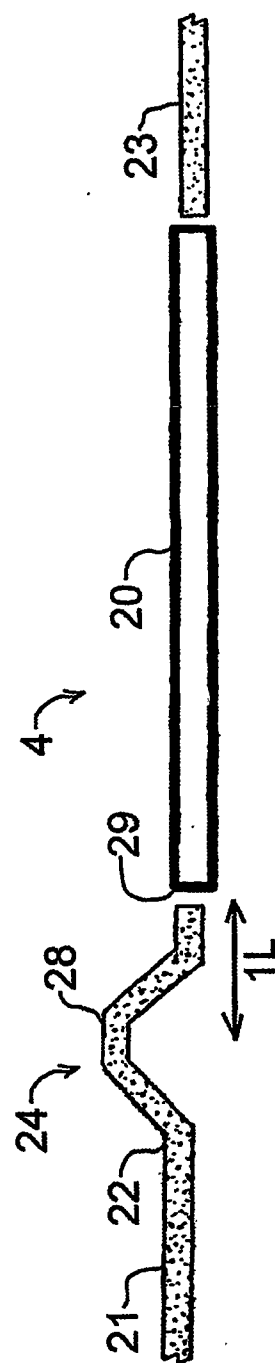
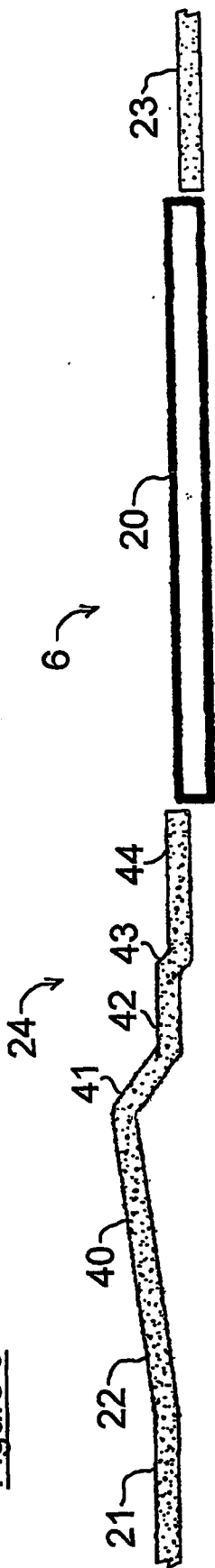
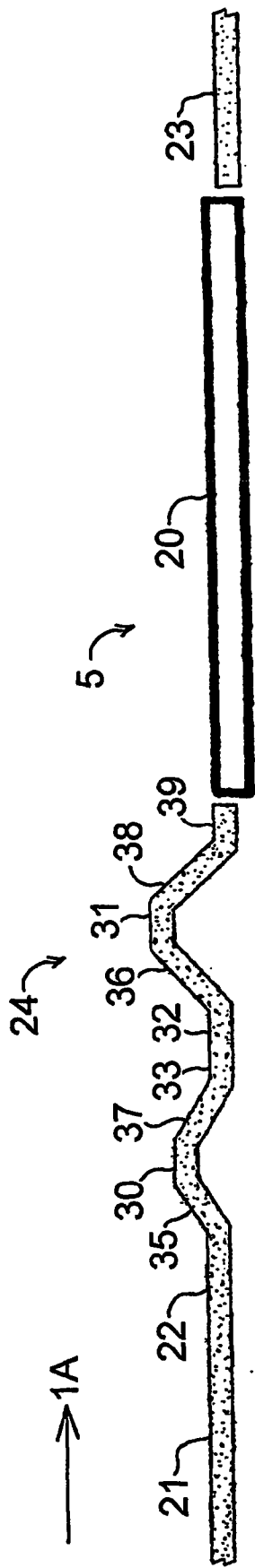


Figure 4



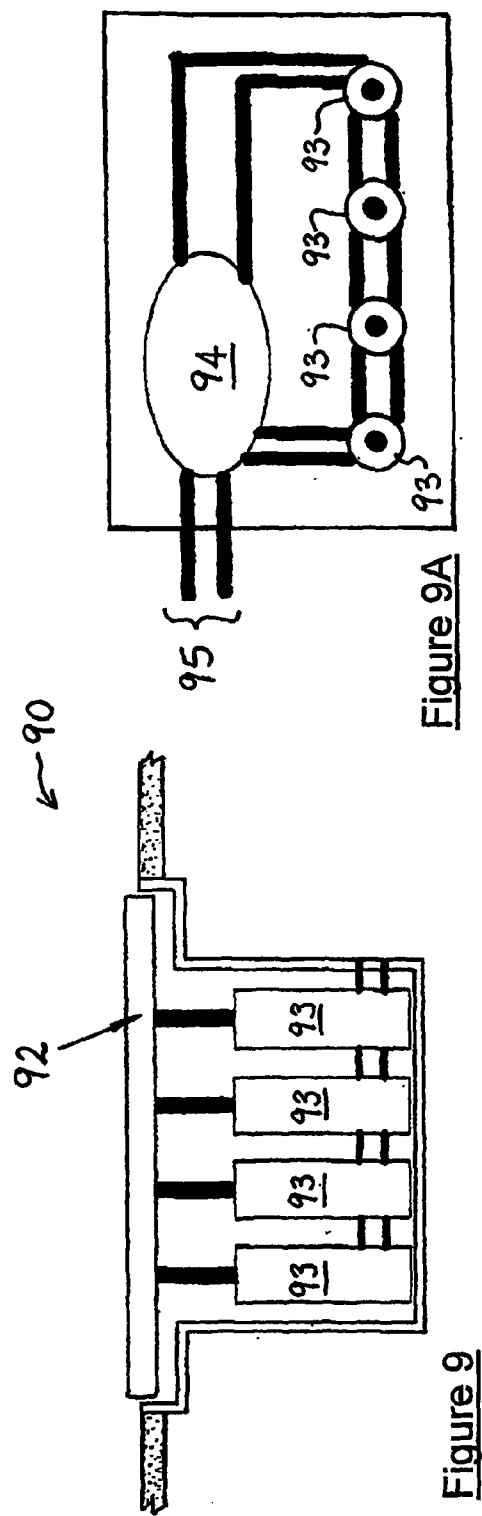
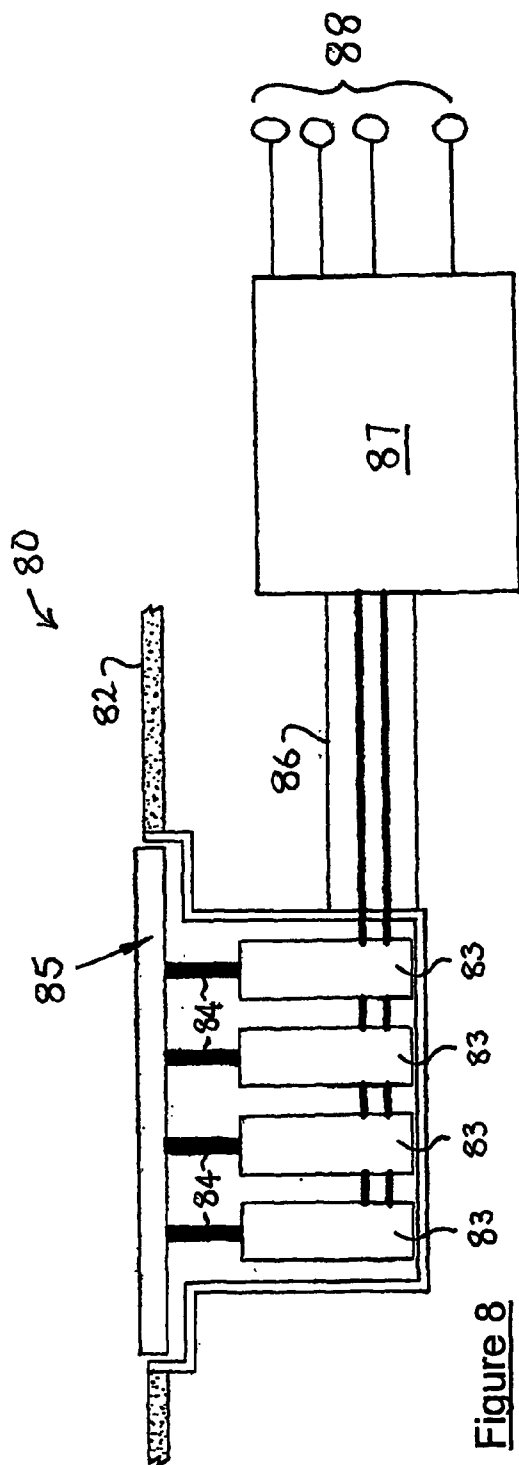


Figure 9A

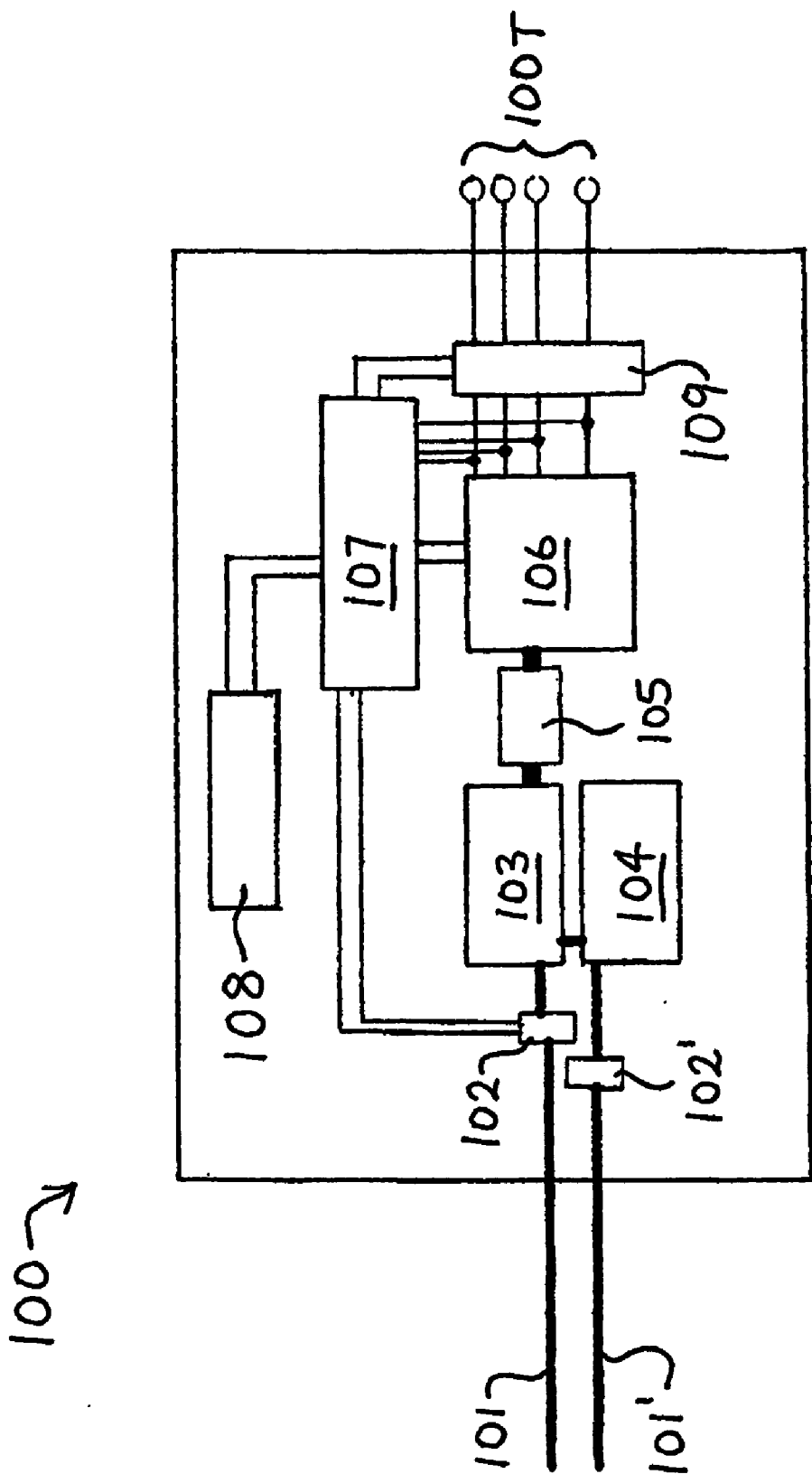


Figure 10

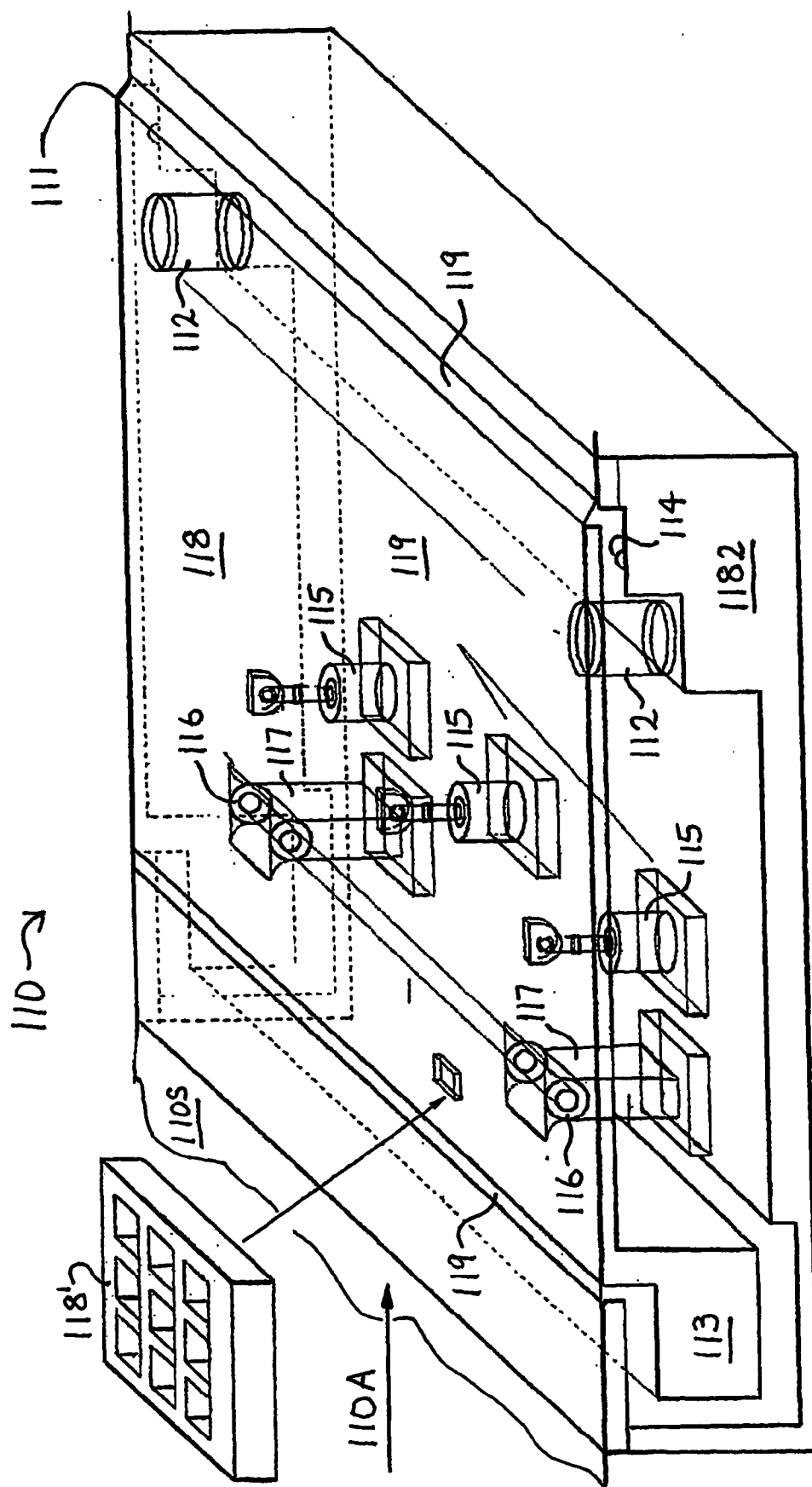


Figure 11

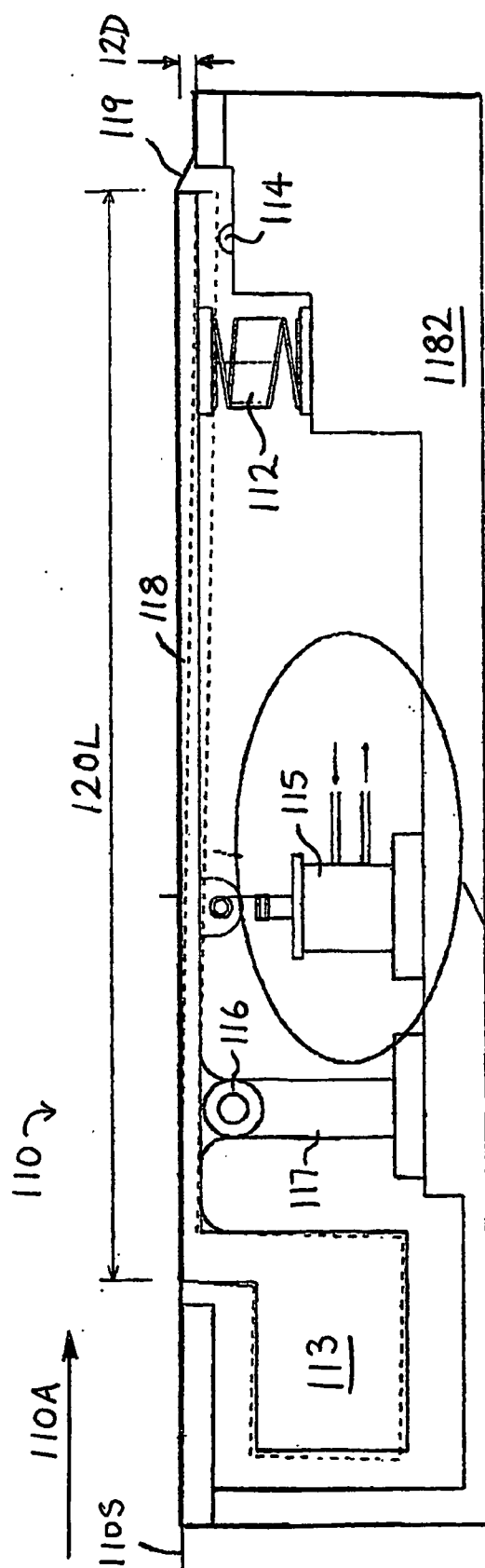


Figure 12

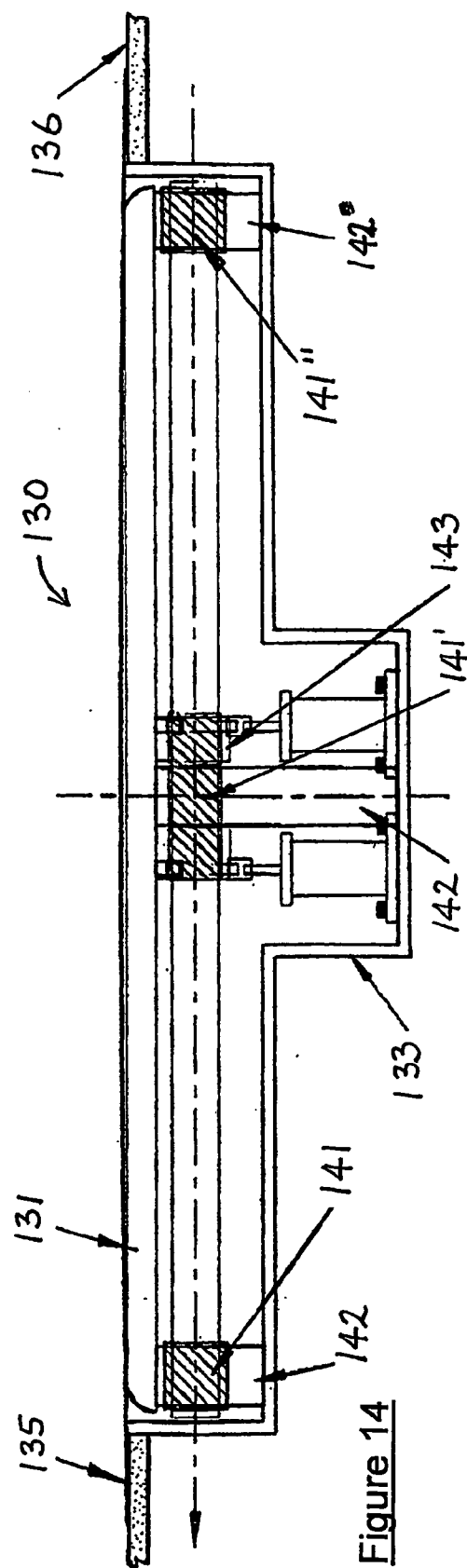


Figure 14

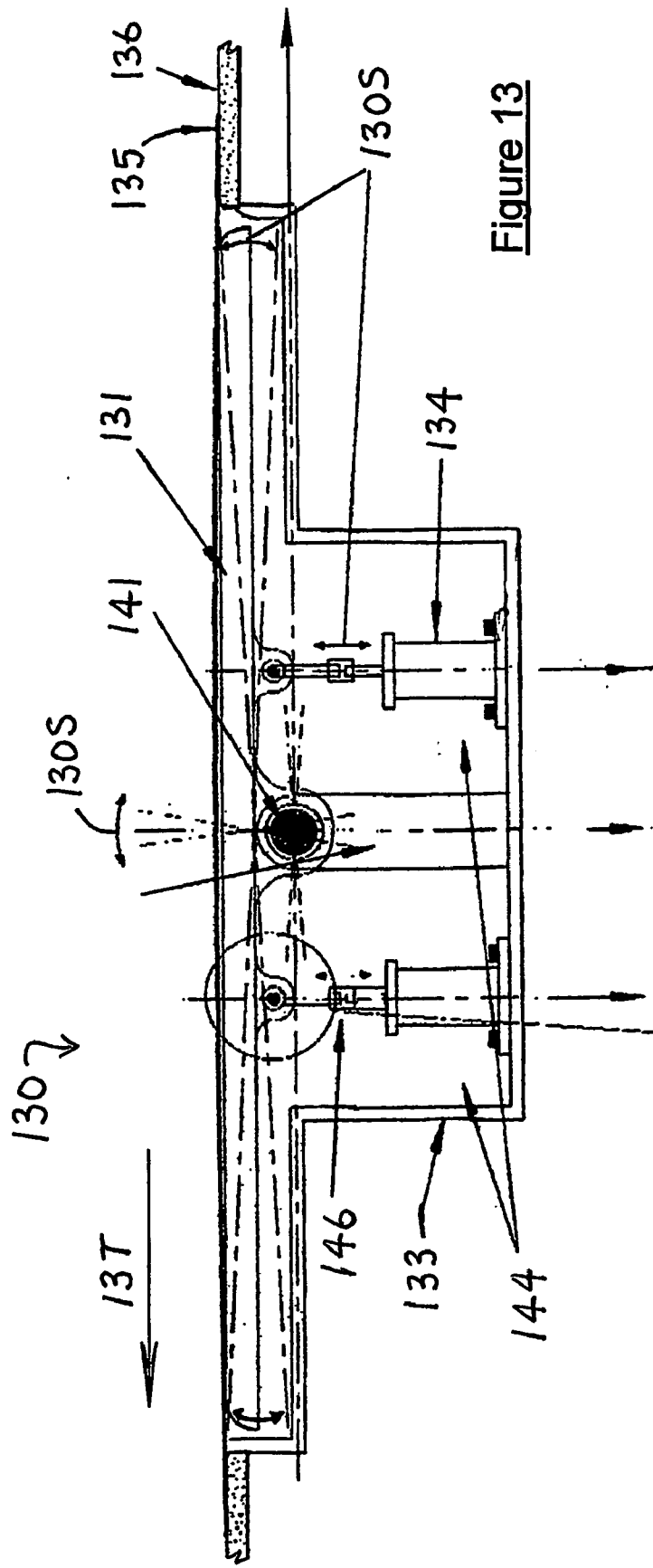


Figure 13

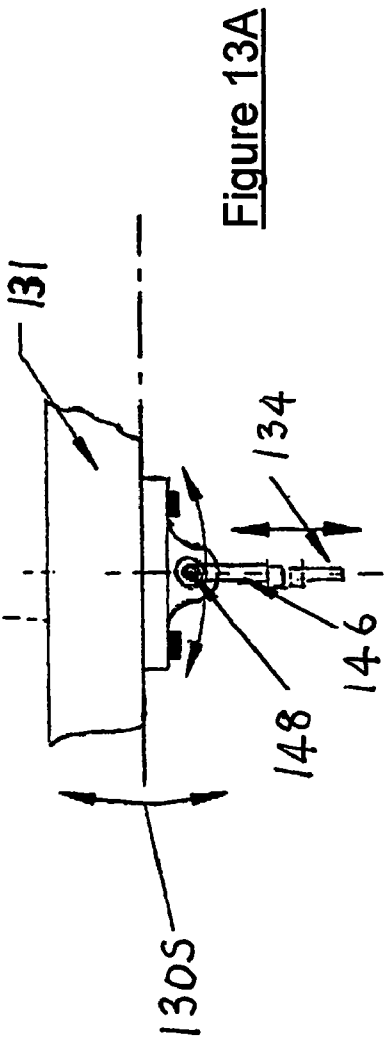


Figure 13A

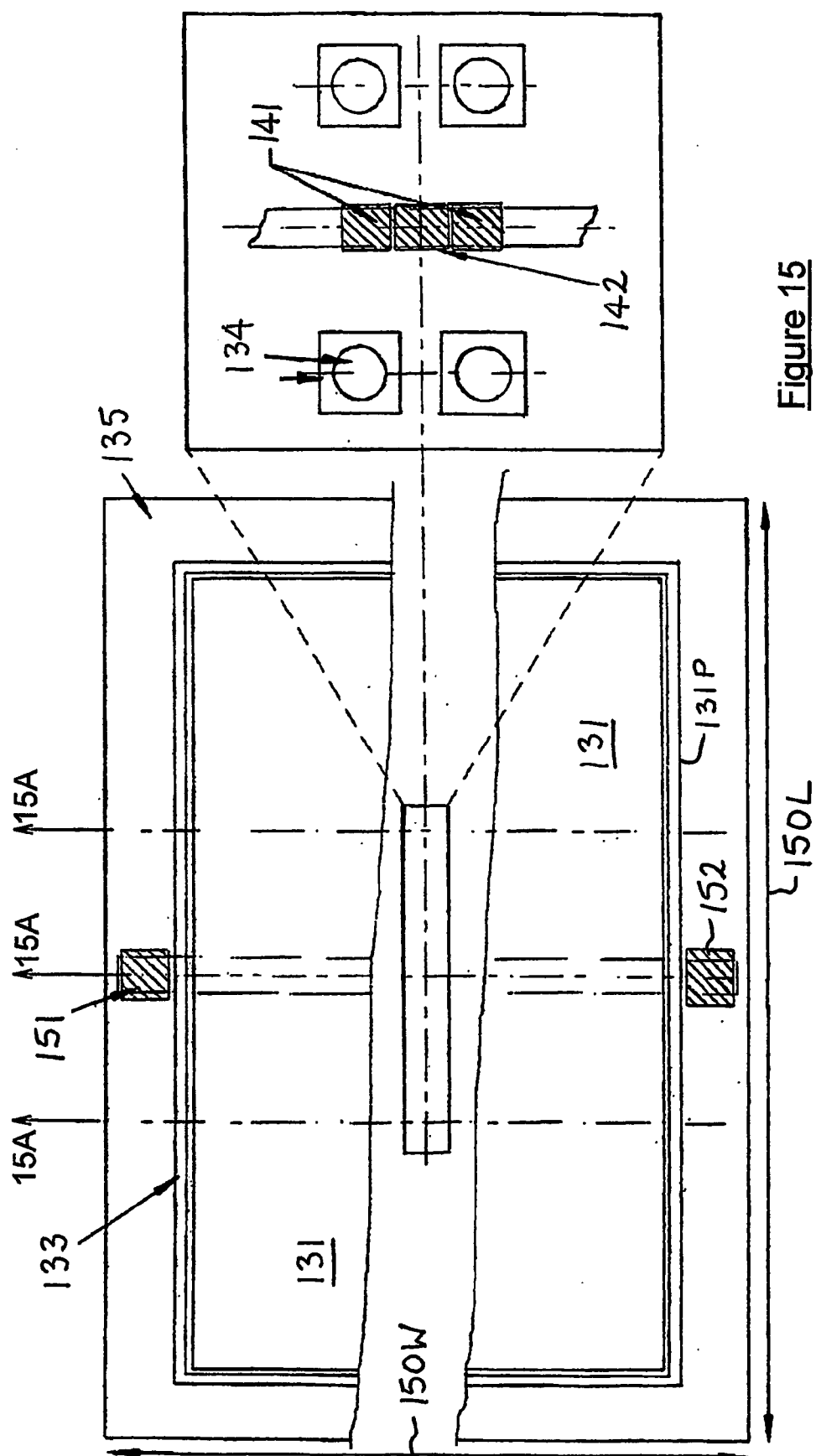


Figure 15

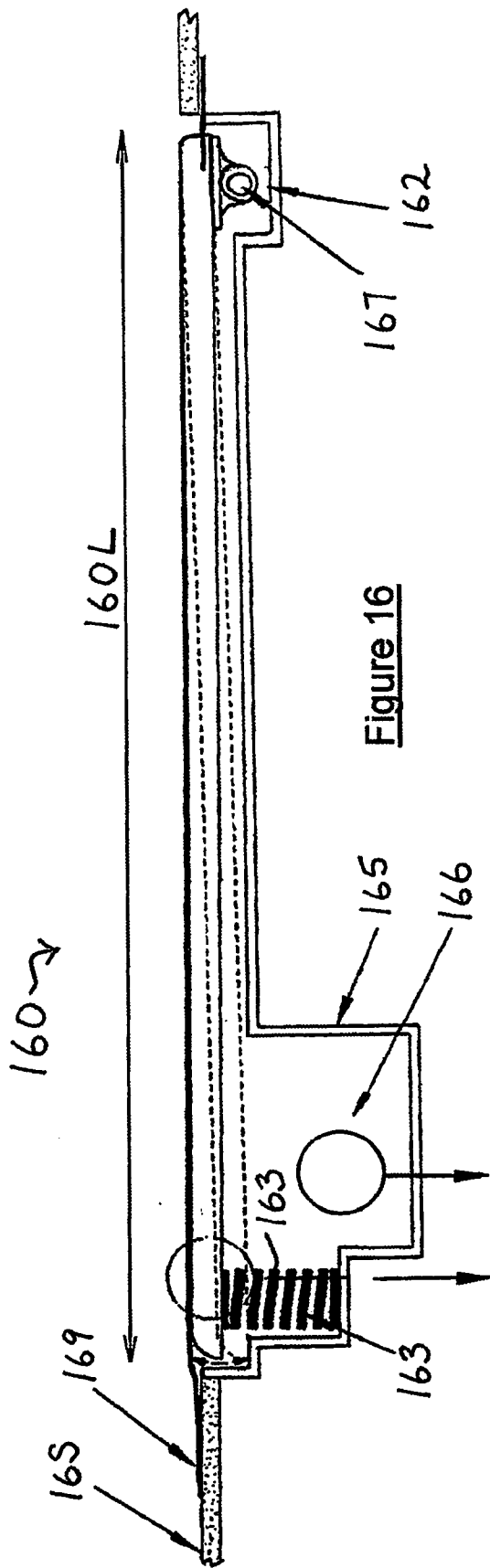


Figure 16

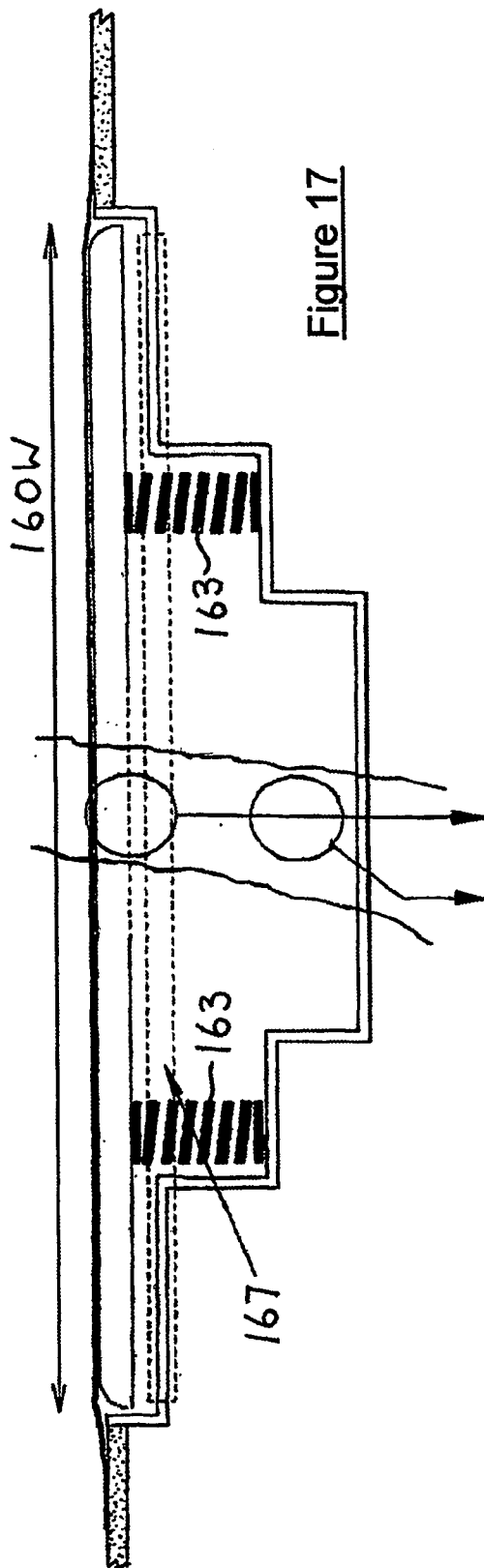


Figure 17

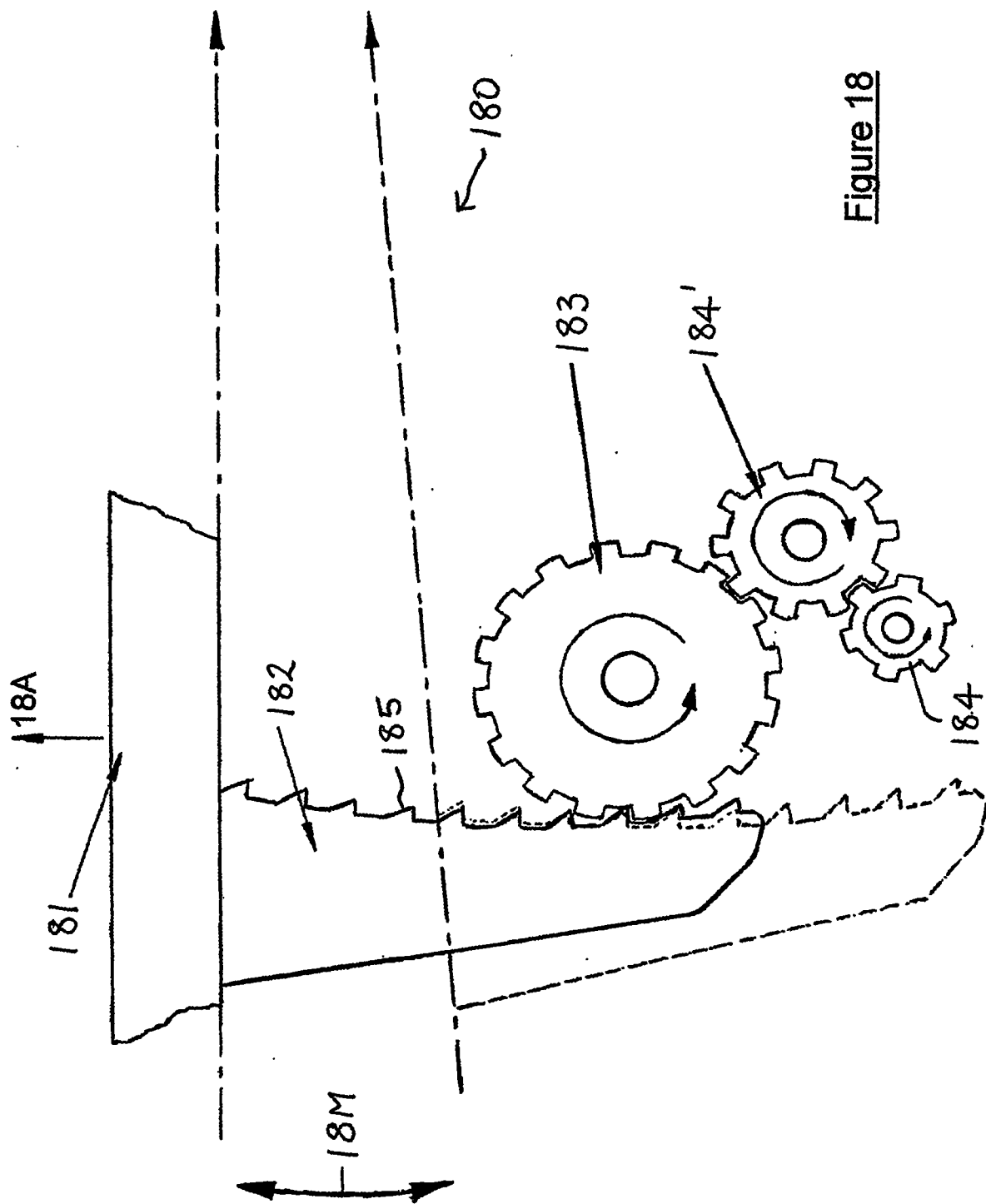
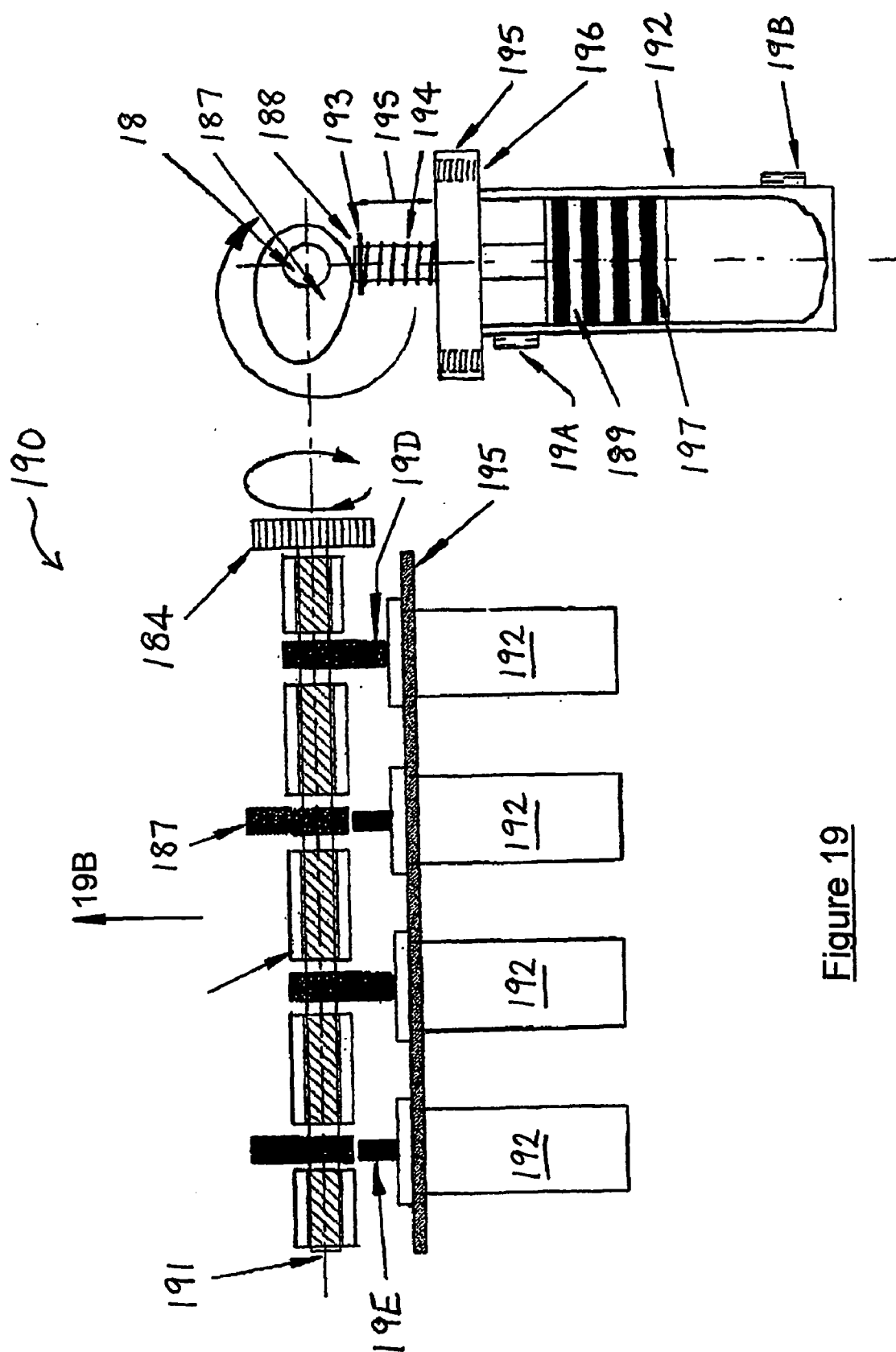


Figure 18



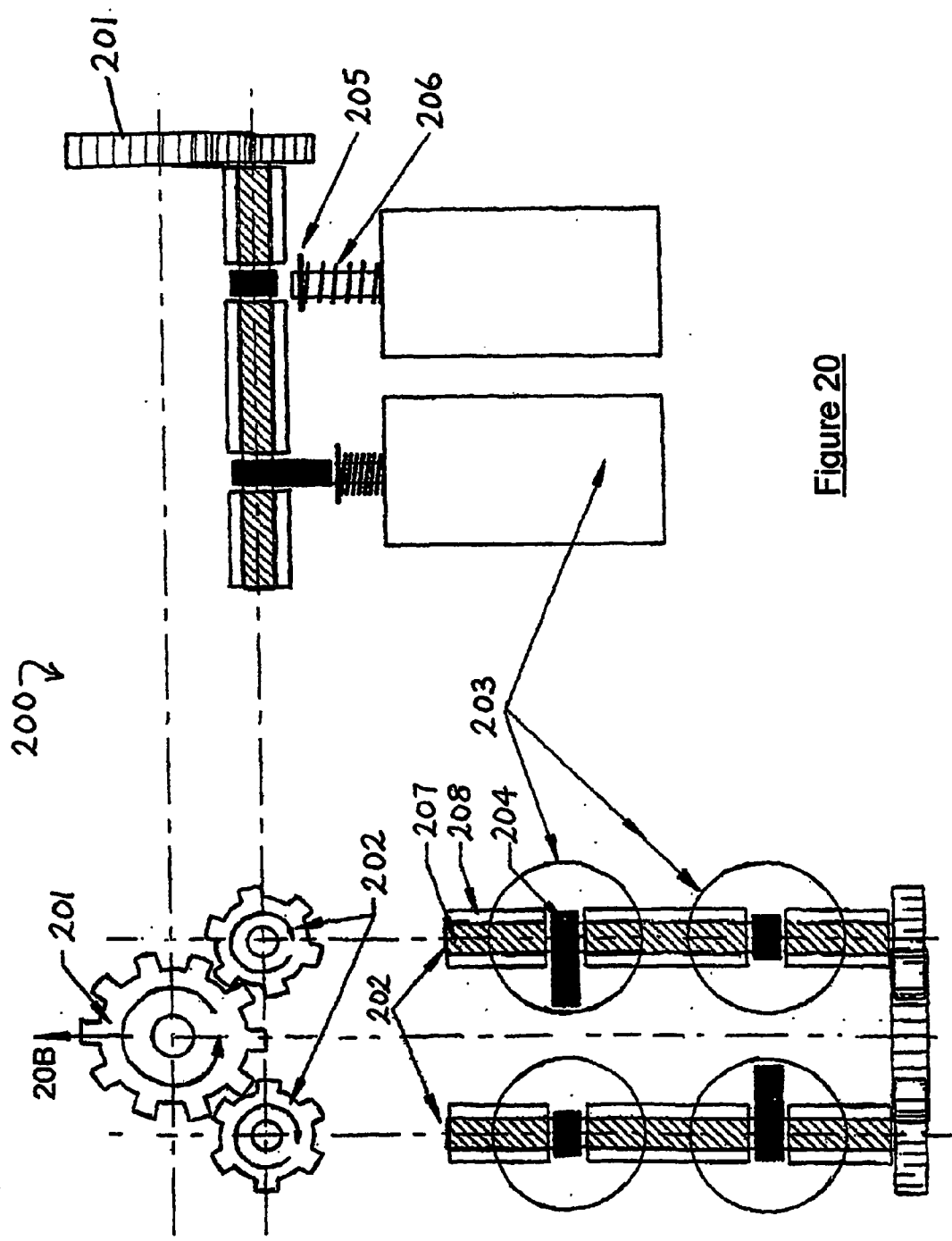
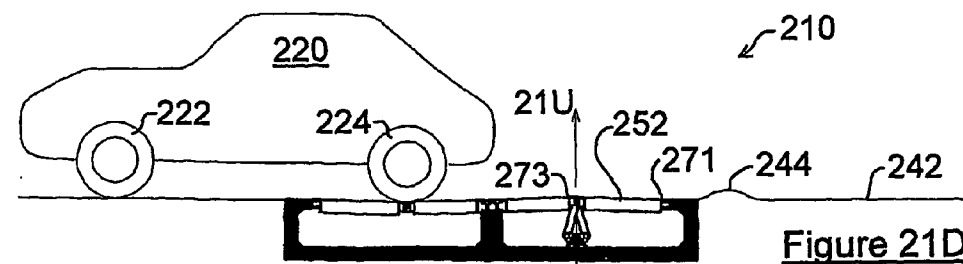
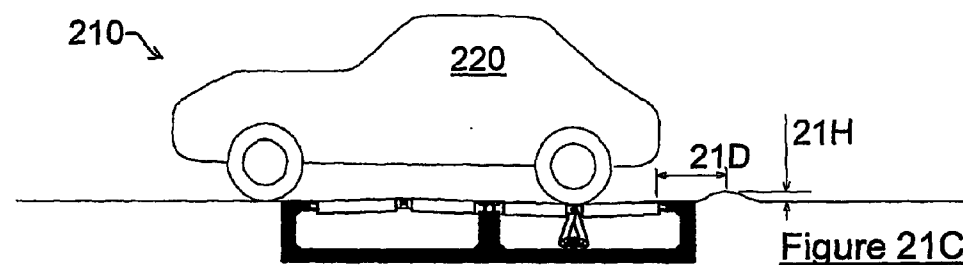
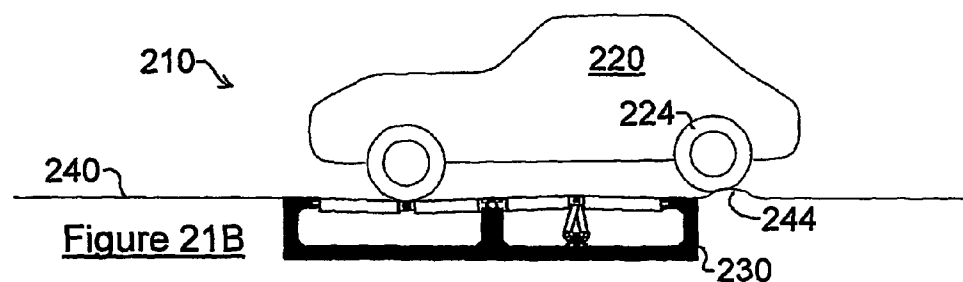
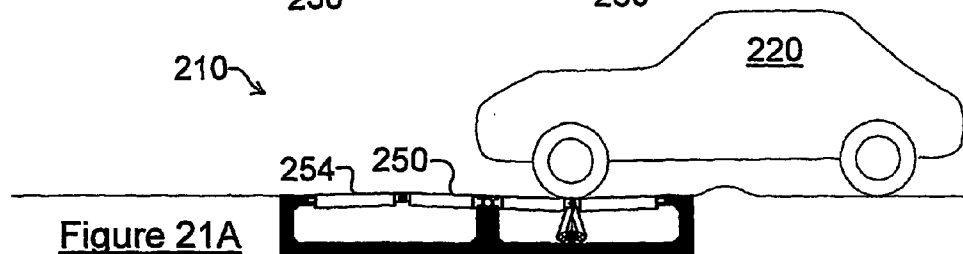
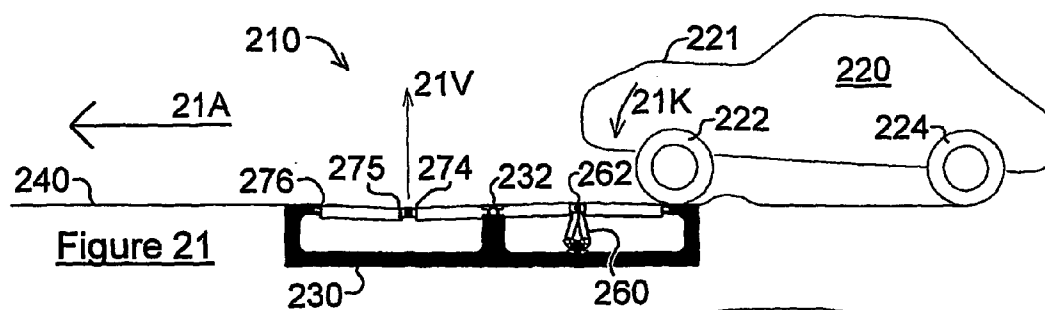
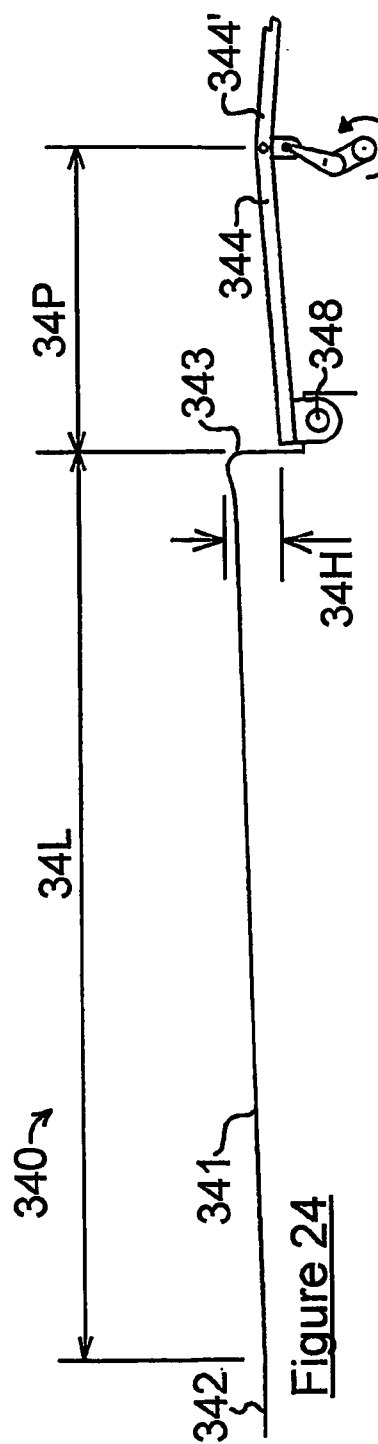
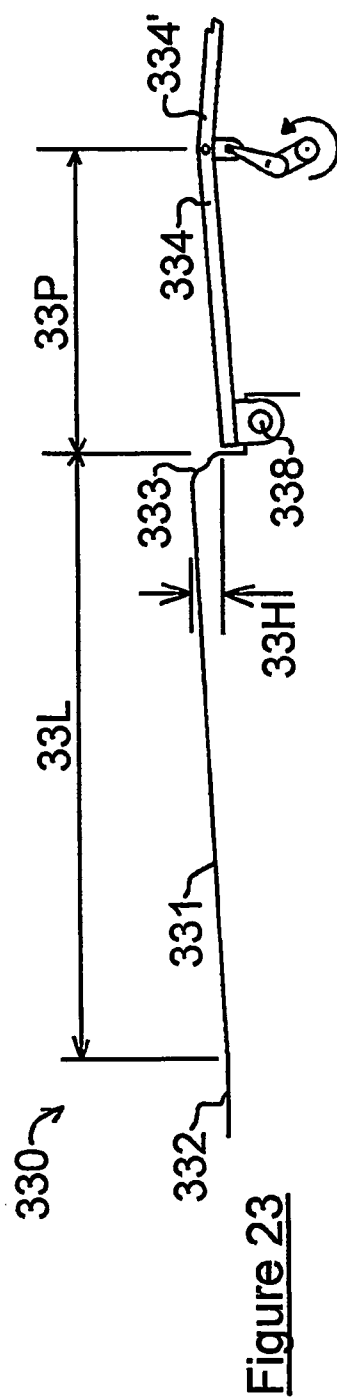
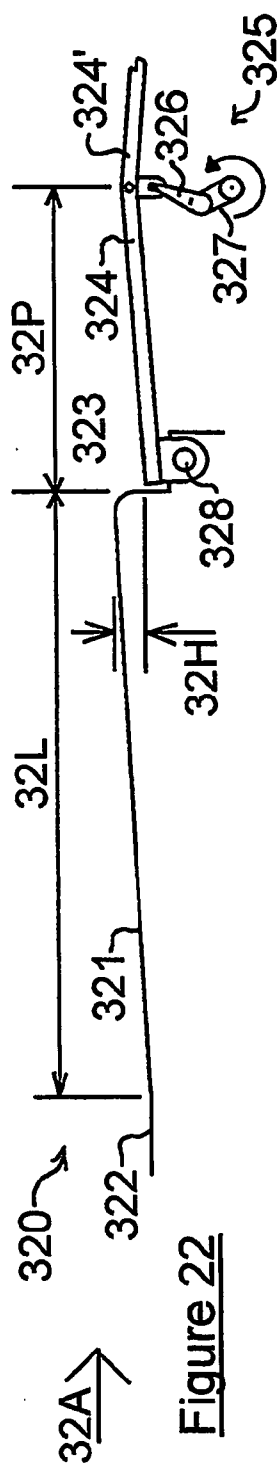


Figure 20





APPARATUS FOR CONVERTING KINETIC ENERGY

[0001] The present invention relates to apparatus for converting kinetic energy from passing vehicles into useable power.

[0002] It is well known that a construction known as a "sleeping policeman" or speed ramp generally comprising a raised area transverse to the alignment of the road is widely utilized for the purpose of slowing vehicular traffic down. As the vehicle crosses the "sleeping policeman" speed ramp resulting in the vehicle being forced to slow down also resulting in an impact being exerted on the vehicle which is generally absorbed by the suspension.

[0003] Since these traffic devices are often associated with built-up areas it will be readily understood that save for the slowing down of traffic which it is claimed results in a reduction in accidents there is no other apparent benefit. Conversely vehicles approaching these speed ramps compel the driver to brake and therefore reduce engine speed and following passing over the ramp to accelerate causing an increase in pollution.

[0004] In the alternative traffic calming devices as they are presently known comprise a chicane and/or width restrictors. When designs of this type are examined it will be readily appreciated that the vehicle has to follow a snake like path through them frequently changing trajectory resulting in a destabilizing of the vehicle. This will be particularly apparent on wet or icy road surfaces. At the time of making this patent application these chicane traffic calming devices are relatively new and for the most part have not experienced winter conditions.

[0005] In both the traffic calming processes previously described it will most certainly result in greater environmental pollution being generated. It may well in the fullness of time transpire that the increased pollution created by these sleeping policemen/speed ramps and chicanes may cause more fatalities and illness than the speeding vehicles if the speed ramps or chicanes were not present.

[0006] According to the present invention, there is provided apparatus for converting kinetic energy into useable power comprising a frame arranged to be fixed in a vehicle running track, a plate moveably mounted to the frame and power transmitting means coupled both to the plate and a power generator, the plate being arranged to act on the power transmitting means to cause power to be generated, and wherein the track and plate are so disposed as to cause at least a part of a vehicle moving on the track to drop onto the plate.

[0007] Means for causing the vehicle to drop may be the provision of a raised portion of the track immediately in front of the plate, or alternatively the plate being mounted below the level of the track.

[0008] The relative disposition of track and plate according to the invention is such that additional kinetic energy is transmitted to the generator as distinct from known arrangements where a moving vehicle moves onto a plate at substantially the same level as the surrounding running track.

[0009] A benefit of imparting a vertical movement to a part of the vehicle prior to it crossing the plate is that the efficiency of the apparatus is enhanced.

[0010] Examples of a running track include amongst others, a roadway or a driveway or a pathway. Such running tracks may be used for traffic flowing in one direction only on a single track or a multi-track carriageway, or may be used for two-way traffic, such as a single track road or path in a rural location.

[0011] Preferably a raised portion of the running track may be in the form of a hump or a ramp.

[0012] Preferably in an alternative embodiment a depression is combined with a such hump.

[0013] Further, the position in respect of the plate may be structured such as to cause a maximum drop or descend onto the plate for a given vehicle approach speed or range of vehicle approach speeds.

[0014] Preferably means is provided in close proximity to the plate so as to cause at least a part of a vehicle that is about to cross the plate to rise immediately in front of the plate, causing in part a reaction on the suspension of the vehicle.

[0015] Preferably the plate is disposed at a level below the track level.

[0016] Preferably the apparatus further comprises a raised portion of the track immediately in front of the plate.

[0017] Preferably in an alternative embodiment, the plate is mounted above the level of an existing track level. More preferably in the alternative embodiment, a rising portion of track is provided to raise an approaching vehicle to the level of the plate, before the vehicle passes over the raised portion of the track immediately in front of the plate.

[0018] Preferably the plate is pivotally mounted.

[0019] More preferably the plate is pivotally mounted between the two ends in the running direction.

[0020] Preferably the plate is coupled to the transmitting means by means of an arrangement whereby the plate drives the generator in its at least downward stroke and/or recovery stroke.

[0021] Preferably the means for driving the generator with both strokes comprises a spragging clutch.

[0022] Preferably the means for driving the generator with both strokes comprises a double acting cylinder arrangement.

[0023] Preferably the hump comprises at least one fixed raised hump or depressed hump in or on the road surface since the vehicles suspension preferably requires to be compressed in order to deliver the most efficient impact to the moveable plate or plates hereinafter described.

[0024] A further benefit of the invention is to provide a suitable convenient alternative to a 'traffic calming' arrangement, such as the sleeping policeman and the chicane while providing a substantial benefit to the environment and utilizing energy that would otherwise be lost.

[0025] Such an embodiment arranged for traffic calming would preferably include multiple humps on the track over which a vehicle approaches the ramp. More preferably, the humps would be of increasing size, and would be arranged to ensure that a majority of vehicles would be likely to approach the ramp at an optimum speed for obtaining power and for the comfort of vehicle occupants.

[0026] Preferably the movable plate comprises a movable element that is an aluminium plate or plates, steel or other suitable material plate which is hinged either in the middle or one end.

[0027] Preferably the plate incorporates a counter balance weight or mechanism. preferably the entire plate or plates described are covered by an elastomeric membrane (a rubber or other suitable material mat).

[0028] The said plate or plates has placed under it a mechanism that by way of example would comprise a rack and pinion gear. A vehicle passing over the said plate or plates will exert forces both gravitational impact and all other energy components related to the forward and rolling motion and momentum and gravitational forces of the said vehicles thereby imparting the energy through the plate or plates to the rack and pinion or other mechanism which in turn drives, for example, a rotary or reciprocating hydraulic or pneumatic pump which is in turn preferably connected to an accumulator or storage vessel for storing hydraulic pressure or air resulting from the pump having been rotated. This in turn is preferably connected to a further pump.

[0029] The pressure referred to is delivered from the accumulator to the pump preferably by a valve system which may deliver on demand or by any predetermined order that is designed into the said system. The second pump referred to may be so arranged to drive an electrical generator. Any suitable number of pumps and/or accumulators or storage vessels may be employed in the invention referred to and any number of plates may be interconnected.

[0030] The generator may be kept rotating or may be allowed to come to rest except when required to deliver electrical energy. In one further convenient embodiment it is proposed to utilise within this development a generator with movable magnets in order to allow minimal inertia to be inherent within the system. It will be readily understood that the energy imparted by vehicular traffic over the plate or plates will vary in frequency from a number per second to a number per hour or in some instances for example during the night to none for some hours and back to a number per second.

[0031] The hydraulic accumulators or storage vessels which may equally be pneumatic or any other suitable storage medium are preferably designed to hold their pressure for substantial periods. However in one further convenient embodiment of this invention it is proposed to incorporate the facility whereby the minimal amount of inertia is present and in order to do so it is proposed that for the most part the hydraulic or pneumatic medium used to transmit the energy to the generator shall be constantly flowing since oil or the like medium has its own inertia as does a generator or pump that has come to rest.

[0032] It is therefore proposed that in incorporating magnets that remove the field from the generator, its resistance to rotation will be substantially minimized. Equally so the hydraulic pump or pumps or pneumatic pump or pumps may be by way of example of a vane type pump whereby the vanes are capable of feathering to bring about the minimal resistance to rotation. Therefore the whole mechanism described herein will be capable of being kept energized or in motion by the residual pressure in the accumulator/accumulators described thereby resulting in the ability of the invention described to deliver energy within a minimum time frame.

[0033] In yet a further alternative and convenient embodiment the plate or plates may incorporate in the place of or in addition to the hydraulic or pneumatic system described above a single or series of fly wheels which may be so coupled to the plate or plates as to accelerate as a result of each vehicle passing over the plate or plates and deliver from the said fly wheel energy either to a suitable gear mechanism or to drive the previously described hydraulic or pneumatic systems or any such other convenient arrangement to utilise the energy collected via the plate or plates. Some of the objects of the invention described herein are referred to hereafter.

[0034] By way of example it is proposed to provide a means of powering street lighting systems without the necessity to draw power from conventional sources of supply for example the National Grid. In another example the apparatus may be used to supply power to the national grid.

[0035] Whilst it is practical for the power plate invention described herein to work effectively either on level, upward or downward gradients, it will be apparent that it is preferably for the plates to be located in sites that are downward gradients thereby utilizing the gravitational forces substantially reducing the effect of the loss of power from the vehicle.

[0036] It will also be readily understood that in these circumstances since the plate is being depressed by the vehicle from the moment the vehicle enters the edge of the plate it should render it unnecessary for any breaking to be required but can still act in a dual capacity of power generation plate and/or speed restricted. It will also be readily understood that power generated by the said plate or plates may also be utilized to light traffic signs in remote areas where it is uneconomical at the present time to feed the light sources from more conventional power supplies by way of example a hair-pin bend in a remote rural area or utilized for powering temporary or permanent traffic lights.

[0037] Yet a further application may be provided whereby a pump is driven to remove the surface water that has gathered and expel it into the drainage system or onto the adjacent land. In the alternative, the pump may be used to purge the drainage system. A further convenient embodiment of the invention is to provide a means for recharging battery powered motor cars whereby the generator provides an electricity supply from any suitable pick up point it will be readily understood that the plate will be activated by the vehicle passing over it on a preferably downward incline such incline may be slight or of any suitable gradient in such circumstances gravity will form the major influence upon the passage the vehicle.

[0038] The apparatus for converting kinetic energy into useable power described herein may also serve a dual purpose in providing traffic calming or speed restricting in addition to its other described functions.

[0039] Preferably the apparatus for converting kinetic energy into useable power also comprises a frame mountable in a running track such as a road or other suitable location, a plate mounted to the frame in such a manner as to allow the plate to move up and down about an axis of a hinge fixed adjacent to or at the leading or trailing edges or at any such other position as shall be suitable to allow upward and downward motions of the plate to be achieved.

[0040] Preferably when mounted in a road at least a portion of the plate is above the level of the road surface.

[0041] More preferably a portion of the plate is inclined above the road level.

[0042] Preferably the plate having a upward protrusion above the road level but which by virtue of its design will be level if it is required that the apparatus for converting kinetic energy into useable power using the plate is to be taken out of use for example in the event of mechanical failure or in such circumstances that weather conditions render its use impractical.

[0043] A link from the plate to a power accumulator and an electrical generator preferably driveable from an accumulator or accumulators or other storage vessels. Alternatively the link may be arranged to drive a pump or pumps or fan or fans or other mechanisms.

[0044] The accumulator or accumulators may be mechanical in the form of a flywheel or an hydraulic or pneumatic accumulators or an air receiver or receivers. In yet a further convenient embodiment of this invention it is proposed that a number of plates are inter-linked either hydraulically pneumatically or electrically and may act in unison or sequentially or spasmodically.

[0045] The plate or plates are preferably pivotally mounted to the frame at its edge, or any suitable point.

[0046] The plate may be segmented at more than one point to form a ramp arranged for a vehicle's wheels to pass over before the vehicle's wheels run onto a further section of the plate. More preferably one or more of the segmented sections of the plate may be linked by a hinge or other convenient means of linking.

[0047] In an alternative embodiment, the segmented sections are not linked.

[0048] The plate may be centrally pivoted or pivoted at any suitable point such as at one end.

[0049] Specific embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

[0050] **FIG. 1** is a diagrammatic cross-section of a first embodiment of an apparatus for converting kinetic energy into useable power according to the invention;

[0051] **FIG. 2** is a diagrammatic cross-section of a second embodiment of an apparatus for converting kinetic energy into useable power according to the invention;

[0052] **FIG. 3** is a diagrammatic cross-section of a third embodiment of an apparatus for converting kinetic energy into useable power according to the invention;

[0053] **FIG. 4** is a diagrammatic cross-section of a fourth embodiment of an apparatus for converting kinetic energy into useable power according to the invention;

[0054] **FIG. 5** is a diagrammatic cross-section of a fifth embodiment of an apparatus for converting kinetic energy into useable power according to the invention;

[0055] **FIG. 6** is a diagrammatic cross-section of a sixth embodiment of an apparatus for converting kinetic energy into useable power according to the invention;

[0056] **FIG. 7** is a diagrammatic cross-section of a seventh embodiment of an apparatus for converting kinetic energy into useable power according to the invention;

[0057] **FIG. 8** is a diagrammatic cross-section of a hydraulic energy conversion apparatus suitable for use with any of the preceding embodiments of the invention;

[0058] **FIG. 9** is a diagrammatic cross-section of a pneumatic energy conversion apparatus suitable for use with any of the preceding embodiments of the invention;

[0059] **FIG. 9A** is a plan view of the pneumatic energy conversion apparatus of **FIG. 9**;

[0060] **FIG. 10** is a block diagram of the hydraulic energy conversion apparatus of **FIG. 8**;

[0061] **FIG. 11** is a diagrammatic layout drawing of a counter-weighted plate apparatus suitable for use with the energy conversion apparatus of **FIGS. 9** or **10**;

[0062] **FIG. 12** is a diagrammatic layout drawing showing a side elevation of the counter-weighted plate apparatus of **FIG. 11**;

[0063] **FIG. 13** is a diagrammatic layout drawing showing a side elevation of a centre-pivoted plate apparatus suitable for use with the energy conversion apparatus of **FIGS. 9** or **10**;

[0064] **FIG. 14** is a diagrammatic layout drawing showing the end elevation of the centre-pivoted plate apparatus of **FIG. 13**;

[0065] **FIG. 15** is a diagrammatic layout drawing showing the plan view of the centre-pivoted plate apparatus of **FIGS. 13** and **14**;

[0066] **FIG. 16** is a diagrammatic layout drawing showing a side elevation of an end pivoted plate apparatus suitable for use with the apparatus of **FIGS. 1** or **7**;

[0067] **FIG. 17** is a diagrammatic layout drawing showing an end elevation of the centre-pivoted plate apparatus shown in **FIG. 16**;

[0068] **FIG. 18** is a diagram of a rack and pinion ratchet arrangement suitable for use with the plate shown in **FIGS. 16** and **17**;

[0069] **FIG. 19** is a diagram of a camshaft arrangement suitable for use with the arrangement of **FIG. 18**;

[0070] **FIG. 20** is a diagram showing three views of an alternative camshaft arrangement suitable for use with the arrangement of **FIG. 18**;

[0071] **FIG. 21** is a diagrammatic side elevation of a vehicle approaching apparatus for converting kinetic energy into useable power according to the invention;

[0072] **FIG. 21A** is a further diagrammatic side elevation showing the same vehicle and apparatus for converting kinetic energy into useable power as **FIG. 21**, with front wheels of the vehicle resting on the apparatus;

[0073] **FIG. 21B** is a further diagrammatic side elevation showing the same vehicle and apparatus for converting kinetic energy into useable power as **FIG. 21**, with rear wheels of the vehicle approaching the apparatus;

[0074] **FIG. 21C** is a further diagrammatic side elevation showing the same vehicle and apparatus for converting kinetic energy into useable power as **FIG. 21**, with front wheels of the vehicle leaving the apparatus;

[0075] **FIG. 21D** is a further diagrammatic side elevation showing the same vehicle and apparatus for converting kinetic energy into useable power as **FIG. 21**, with only rear wheels of the vehicle resting on the apparatus;

[0076] **FIG. 22** is a diagrammatic cross-section of a eighth embodiment of an apparatus for converting kinetic energy into useable power according to the invention;

[0077] **FIG. 23** is a diagrammatic cross-section of a ninth embodiment of an apparatus for converting kinetic energy into useable power according to the invention; and

[0078] **FIG. 24** is a diagrammatic cross-section of a tenth embodiment of an apparatus for converting kinetic energy into useable power according to the invention.

[0079] From **FIGS. 1 to 7** and **FIGS. 22 to 24** it will be readily understood that a vehicle passing over the movable plate will experience an initial shock wave causing its suspension to react in absorbing the said shock wave. A benefit of providing the approach ramp surface is to result in the suspension being depressed causing the vehicles suspension to be compressed at the point of impact on the movable plate of the apparatus for converting kinetic energy into useable power.

[0080] In describing the approach ramp this may comprise one or more upward or downward curvatures in the road surface to react on the vehicle's suspension to optimise the energy delivered by the vehicle to the power plate herein described

[0081] From **FIGS. 1 to 7** and **FIGS. 22 to 24** ten alternative apparatus for converting kinetic energy into useable power **1, 2, 3, 4, 5, 6, 7, 8, 9** and **10** are shown which are embodiments of the invention. Each apparatus comprises a moveable plate **20** coupled to a power transmitting means (not shown in these figures) to transmit power to a generator (not shown in these figures), and a vehicle running track **22** and **23**. Vehicles approach the apparatus in the direction of arrow **1A**, running across track **22** first, then across the plate **20**, and leaving across the track **23**. To enhance the efficiency of the operation of the apparatus, a portion of the approach track **24** is raised so as to cause the approaching vehicle to drop as it runs onto the plate **20**. The portion of approach track **24** may be profiled according to the local situation of the apparatus and the anticipated vehicle approach speeds. For high approach speeds a shallow fall such as falling surface **25** may be appropriate. In this first embodiment a final approach surface **19** is substantially horizontal, and is height **1H** below a surface **21** of the running track **22**. The second embodiment **2** has a long raised hump **26** with a centre of the hump being a distance **2L** from a leading edge **29** of the plate **20**. The third embodiment has a short, low raised hump **27**. The fourth embodiment has a short, high raised hump **28**. Since vehicles are likely to traverse the short raised hump **28** more slowly, it is positioned so that its highest point is a short distance **1L** from the leading edge **29** of the plate **20**. The short distance **1L** is shorter than a longer distance **2L** where the anticipated approach speed is higher. The fifth embodiment comprises a plurality of humps **30** and **31**, and although only two humps are shown more may be

provided for a specific installation of the apparatus. A depression **32** is formed between the two humps **30** and **31**. A floor **33** of the depression **32** may be at a level above or below the level of the surface **21** approach track **22**. Hump **30** comprises a rising slope **35**, then a substantially horizontal plateau portion followed by a falling slope **37**, similarly hump **31** comprises a rising slope **36** followed by a substantially horizontal portion followed by a falling slope **38**, which leads onto a final approach surface **39**. Such multiple humps, particularly where the height increases as the humps near the plate may be used to ensure approaching vehicles reduce their speed as they approach the plate in a particular location. It will be appreciated that the angle of the slopes **35, 37** and **36** and **38** and or the heights and or the lengths of the plateau portions and or the length and depth of the depression **32** may be adjusted to optimise the efficiency of the humps. From **FIG. 6**, embodiment **6** comprises a long shallow slope **40** followed by a shorter steeper slope **41**, followed by a plateau region **42** joined by a short steeper slope **43** to a final approach surface **44**. There is substantially no plateau region between the slope **40** and the slope **41**, and while in these Figures the joining of two surfaces adjacent surfaces, such as that between slope **40** and slope **41** is shown as a substantially sharp corner, in practice, because of the nature of the materials used for road surfaces to obtain a durable surface, such comers may be smoothly blended with a large radius without detracting from the benefits achieved from the provision of the humps in the approach surface. From **FIG. 7**, embodiment **7** may be seen to comprise a long shallow slope **45** followed by a short steeper slope **46** to a final approach surface **47** leading onto plate **20**. In all of the Figures from **1 to 7** and **22 to 24**, the hump is of substantially the same width as the plate, and preferably stretches across the running track from one side to the other. In alternative embodiments similar in all respects to embodiments **1 to 10** apart from the profiled portion of the approach track or hump having a central portion with a level or smoothly changing gradient along the direction of travel of vehicles approaching the apparatus so as to provide cyclists and motorcyclists with a smooth and safe approach to enable them to cross the apparatus safely.

[0082] **FIG. 8** shows by way of example the general layout for a power conversion unit **80**. In this example there are shown below the level of the surrounding road surface **82**, four hydraulic cylinders **83** with their piston rods **84** connected to the underside of the moveable plate **85**. It will be readily understood that any number of cylinders or a single cylinder may be provided and that such cylinder may be hydraulic or pneumatic or a convenient combination of both. A connecting tunnel **86** is provided to enable a hydraulic connection to a power conversion unit **87** which may be conveniently situated alongside the running track or carriageway to facilitate easy maintenance. The power conversion unit produce a suitable output **88**, such as three phase electricity or compressed air or other fluid.

[0083] **FIGS. 9 and 9A** illustrate a generator **90**, the plate **92** connected to four cylinders **93** either pneumatic, hydraulic, pump or bellows. The purpose of which is to build up compressed air in an air receiver **94** and release the air from exit **95** in bursts to remove pollution from the general area and cause fresh air to fill the vacated or moved polluted area space. In one further convenient embodiment it is intended to fit a plate or plates within a road or rail tunnel to expel polluted air and draw in or cause to be drawn in fresh air.

[0084] FIG. 10 illustrates a convenient arrangement for a plate power conversion unit 100 and is by way of example. Conversion unit 100 comprises a hydraulic inlet 101 from, for example the cylinders of FIGS. 8 or 9, and a return outlet 101' which are connected through non-return valves 102 and 102' to a hydraulic accumulator 103, and a reservoir tank 104 and hence to a pump 105 which drives a synchronous generator 106, having a control unit 107 and a battery 108, the control arranged to control contactor 109 to switch a three phase output 100T.

[0085] FIG. 11 illustrates an embodiment 110 of a counter weight or balance system earlier referred to in which the main body of the plate is fabricated incorporating a counter balance weight 113, and pivotally mounted on bearings 116 and pillars 117 to a preformed frame 1182 which is preferably made of a strong material such as a metal or reinforced concrete. The pre-formed frame is set into the running track, so that it is preferably substantially flush with the surrounding surface. The moving edge 111 of the plate may be provided with return springs 112. It will be apparent that in utilizing a counter balance 113 the spring forces will be substantially reduced. An end stop 114 is provided to support the plate in the event of a heavy vehicle passing over. End stop 114 is arranged to prevent damage to the springs or energy collection system, which in this Figure is shown as cylinders 115, but could be any other suitable mechanism. FIG. 11A shows an enlarged portion 118' of the heavily reinforced plate 118, which is preferably covered with a non-slip elastomeric membrane 119, such as rubber or a resilient polymeric material. The membrane 119 extends to cover a gap between the plate and the surrounding running track surface 110S. Vehicles are preferably arranged to approach in the direction of arrow 110A.

[0086] FIG. 12 shows a further example and cross-section of the counter weight/balance plate. It will be readily understood that the counter balance and pivot may be placed at any convenient suitable location. A length of the plate 120L, is in a particular application suitably about 1.2 metres. A dashed outline of the plate, shows its maximum deflected position. A difference between the upper and maximum deflected positions gives a maximum ramp deflection 12D. A suitable value for dimension 12D has been found in a particular embodiment to be 50 millimetres. When in its maximum deflected position the top surface of the plate is substantially level with the running track onto which the vehicle will pass after crossing the plate. Although shown with hydraulic cylinders for use with a hydraulic accumulator, these may equally well be pneumatic bellows and air receiver arrangement to generate a blast of compressed air.

[0087] FIG. 13 illustrates a further alternative embodiment 130 whereby the plate 131 is centrally pivoted at pivot 132. This arrangement enables the plate to received increased impact by virtue of the fact that the front wheels of the vehicle travelling in the direction of arrow 13T will strike the rear of the plate first and be followed by the front wheels depressing the front of the plate and will be followed by the repeat process of the rear wheels of the vehicle or in the case of multi-axled vehicles by repeated impact blows resulting in a see-saw effect indicated by arrows 130S. Support and mounting frame 133 is set substantially flush into the running track, and provides space 144 for the cylinders 134 and routing of pipe work under the plate. A bearing 148 and coupling 146 connects the plate to the

cylinders 134. The plate is covered by elastic membrane 135 which extends over the adjacent running track or road surface 136. The enlarged view shows the connecting rod pivot 137 and connecting rod 138 connecting the plate to the cylinders.

[0088] FIG. 14 further illustrates the centrally pivoted plate apparatus 130 showing the pivot bearings 141, 141' and 141" across the plate, the pivot bearings supported by pillars 142, 142' and 142" from the frame 133. The bearing journals 143 for the cylinders are attached to the underside of the plate.

[0089] FIG. 15 illustrates a plan view and an example of alternative pivot bearings and cylinders for the embodiment 130. Elastic membrane 135 extends around the plate 131, and suitable overall dimensions for a width 150W of the elastic membrane would be 2.15 metres and a length 150L of 1.2 metres. In this alternative arrangement, the pivot bearings 151 and 152 are preferably positioned outside of the profile 131P of the plate 131.

[0090] FIGS. 16 and 17 illustrate two cross-sectional views of an embodiment 160 having a plate 161 pivoted at one end 162 on pivots 167 supported on pillars 168. Return springs 163 are provided at the other end 164. Preformed frame assembly 165 provides space 166 for cylinder and camshaft assembly as described below. In this embodiment, suitable dimensions for the plate would be a width 160W of 2.15 metres and a length 160L of 1.2 metres. The plate is covered by elastomeric membrane 169, which extends to overlap surrounding surface 16S of the running track.

[0091] FIG. 18 illustrates an alternative power transmitting means 180 whereby the plate 181 has mounted beneath its surface a ratchet mechanism 182 to drive a pinion gear 183 and preferably connected through idler 184' to a camshaft drive gear 184. Alternatively the pinion 183 may drive a crankshaft and connecting rod type mechanism (not shown) to reciprocate the hydraulic or pneumatic cylinders previously referred to. Teeth 185 are arranged to disengage on the upward stroke, as the plate moves in the direction of arrow 18M.

[0092] FIG. 19 illustrates an embodiment 190 of a power transmitting means comprising a single cam shaft 191 configuration with four inline cylinders 192 mounted on a mounting plate 19M. This embodiment 190 would be suitable for use with the alternative power transmitting means 180. Embodiment 190, when used with embodiment 180 comprises cam shaft 185 driven by camshaft drive gear 184, mounted in bearings 186 with cam lobes 187 driving piston connecting rods 188 which move piston 189 to pump hydraulic fluid in at 19A and out at 19B. The side elevation shows each piston connecting rod 188 having a spring retaining collar 193, a return spring 194 to return the piston on stroke 19S. Mounting flange 195 has mounting bolt holes 196. Pistons 189 have seals 197. A fully extended piston connecting rod is shown at 19E, and a fully depressed piston connecting rod is shown at 19D.

[0093] FIG. 20 illustrates an embodiment 200 of a power transmitting apparatus comprising a gear mechanism 201 and twin cam shaft 202 with cams 204 arrangement with 2x2 cylinders 203, each having a spring retaining collar 205 and a return spring 206. Cam shafts 202 run in bearings 207 mounted to a bearing housing 208 of a fixed frame of the apparatus. Embodiment 200 is similar to embodiment 190.

[0094] The invention as herein before described and in particular reference to the use of hydraulic cylinders is by way of one example only the plate in the alternative may have provided one or more hydraulic pumps. It will be readily understood that inertial forces play a substantial part in absorbing energy and in the case of hydraulic cylinders the numerous inertial moments will result in mechanical losses brought about by the stopping and starting of the cylinders at the end of their travel. Whereas in the case of a hydraulic pump or pumps the pump or pumps can be so arranged to continuously travel in a particular path of rotation building up pressure within the system and preferable through hydraulic accumulators either by means of being rotated through a gearing system or by direct connection to a shaft which is rotated through an escapement mechanism on each movement of the plate.

[0095] FIGS. 21 to 21D are diagrammatic side elevations of a vehicle 220 approaching apparatus 210 for converting kinetic energy into useable power according to the invention, showing how the apparatus moves as the vehicle passes over the apparatus in the direction of arrow 21A. Since the apparatus and vehicle are identical in all the FIGS. 21 to 21D, labels are omitted from the figures as appropriate in the interest of clarity.

[0096] The apparatus comprises a frame 230 arranged to be fixed in a vehicle running track 240, and a plate 250 moveably mounted to the frame by pivot 232 and power transmitting means 260 coupled both to the plate at trunnion 262 and to a power generator (not shown in FIGS. 21 to 21D). The running track 240 at least on an approach surface 242 comprises a raised portion 244 that extends across the track so that the approaching vehicle 220 must pass over the raised portion before the vehicle runs onto the plate 250.

[0097] Plate 250 comprises three sections, a leading section 252, a centre section 253, and a trailing section 254. The three sections are pivotally connected at their leading and trailing edges to each other or to the frame as appropriate, and hence leading section 252 is pivotally connected to the frame at leading edge 271 and is pivotally connected to the centre section 253 at trailing edge 272 which is connected to a leading edge 273 of the centre section 253. The centre section 253 is also pivotally connected to the trailing section 254, at a trailing edge 274 to a leading edge 275 of the trailing section 254. The trailing section 254 is also pivotally connected to the frame 230 at a trailing edge 276.

[0098] The power transmitting means 260 comprises a connecting rod and sprag clutch arrangement to convert a vertical motion of the plate at the trunnion to a rotary motion of a drive shaft. Although this arrangement maybe suitable for some applications of the apparatus 210, it should be noted that alternative power transmitting means may be more suited to particular applications. Some such suitable alternatives are described with respect to other figures in this application.

[0099] In FIG. 21 the vehicle 220 has passed over raised portion or hump 244 and the raised portion or hump has caused a part of the vehicle, in this instance a body 221 to rise. The vehicle is about to run onto the leading section 252 of the plate 250 as the body 221 is dropping in the direction of arrow 21K. As the vehicle approaches the plate, at this point the leading edge 273 of the central section 253 of the plate is in an 'up' position. As the front wheels 222 pass over

the leading edge the central section pivots and the plate drops. FIG. 21A shows the vehicle with front wheels 222 of the vehicle resting on the apparatus, and having moved the leading edge 273 to a 'down' position causing the trailing edge 274 of the plate to rise in the direction of arrow 21V. This substantially vertical movement is transmitted via a connecting rod to a sprag clutch which causes a drive shaft to rotate.

[0100] In FIG. 21A, the rear wheels 224 have just passed over the highest portion of the raised portion or hump 244 and as the vehicle continues to travel in the direction of arrow 21A are dropping onto the plate leading section 252.

[0101] The raised portion of hump has a height 21H above the approach surface 242, and the highest portion of the raised portion or hump is a distance 21D from the leading edge 271 of the plate leading section 252.

[0102] Suitable dimensions for the height 21H and the distance 21D will depend on the particular requirements of each installation, the anticipated typical vehicle approach speed being an important consideration.

[0103] Such suitable dimensions for 21H would typically be in the range of 25 millimetres to 75 millimetres and for distance 21D would typically be in the range of 100 millimetres to 450 millimetres, although dimensions outside of these ranges will be required for particular applications to obtain an optimum output from the power generating apparatus 210.

[0104] FIG. 21B shows rear wheels 224 of the vehicle approaching the apparatus. As the vehicle moves forward the central plate tips back to its original 'up' position with the leading edge 273 moving in the direction of arrow 21U causing further rotation of the drive shaft via a second sprag clutch.

[0105] FIG. 21C shows the frontwheels 222 of the vehicle 220 leaving the apparatus 210. The rear wheels act as in FIG. 21A, imparting further rotation to the drive shaft.

[0106] FIG. 21D shows only the rear wheels of the vehicle resting on the apparatus. The rear wheels act as in FIG. 21B, giving a final rotation to the drive shaft and leaving the plate in position as shown in FIG. 21 ready for the next vehicle approaching in the direction of arrow 21A.

[0107] Although the description with reference to FIGS. 21 to 21D makes reference to a particular mechanical form of energy conversion mechanism, any of the energy conversion apparatus described herein could be used instead. The sprag clutch arrangement has a particular benefit that energy is collected positively by the mechanism with each movement of the plate. The hydraulic or pneumatic arrangements described herein could be similarly adapted by using double acting cylinders.

[0108] From FIG. 22 a diagrammatic cross-section of a eighth embodiment 320 of an apparatus for converting kinetic energy into useable power according to the invention is shown. The apparatus comprises an inclined ramp 321 of length 32L rising from a running track 322, and ending in a radiused step 323, a height 32H above a plate 324. Plate 324 is pivotally mounted at 328 to a fixed frame mounted in the running track. In use, a vehicle approaches the apparatus in the direction of arrow 32A, and as it travels towards the plate, at least a part of the vehicle, for example, the wheels

and unsprung mass of the vehicle, is deflected upwards by the inclined ramp before dropping onto the plate 324. The action of the vehicle dropping onto and traversing the plate exerts a downwards force on power transmitting apparatus 325, so as to cause a power output from the apparatus. In a particular arrangement of this embodiment, the power transmitting apparatus comprises a connecting rod 326 and crankshaft 327 arrangement to convert the substantially vertical motion of the plate into a rotary output motion from the power transmitting apparatus. The connecting rod 326 is preferably connected to the plate at a hinged joint between two similar plates 324 and 324'.

[0109] It has been found in a particular application that a suitable value for the length 32L is 1220 millimetres, for the length 32P is 610 millimetres, and for the height 32H is 38 millimetres.

[0110] From FIG. 23 a diagrammatic cross-section of a ninth embodiment 330 of an apparatus for converting kinetic energy into useable power according to the invention is shown. The apparatus comprises an inclined ramp 331 of length 33L rising from a running track 332, and ending in a radiused step 333, a height 33H above a plate 334. In operation, embodiment 330 is similar to that of embodiment 320.

[0111] It has been found in a particular application that a suitable value for the length 33L is 1220 millimetres, for the length 33P is 610 millimetres, and for the height 33H is 38 millimetres.

[0112] From FIG. 24 a diagrammatic cross-section of a tenth embodiment 340 of an apparatus for converting kinetic energy into useable power according to the invention is shown. The apparatus comprises an inclined ramp 341 of length 34L rising from a running track 342, and ending in a radiused step 343, a height 34H above a plate 344. In operation, embodiment 340 is similar to that of embodiment 330 and 320.

[0113] It has been found in a particular application that a suitable value for the length 32L is 1829 millimetres, for the length 32P is 610 millimetres, and for the height 32H is 32 millimetres.

[0114] Each embodiment is slightly different, each being better suited to a particular application where particular traffic is anticipated. Hence, each of the radiused steps 323, 333 and 343 differs slightly in its shape, and the proportions of the inclined ramp 341 is significantly longer than that of ramp 321 or 331.

[0115] It will be appreciated that the embodiments described convert kinetic energy from passing vehicles into another form of energy useful in a particular application, such as electrical power or compressed air.

[0116] Reference throughout this application is made to vehicular traffic. It should be readily understood that there is no practical reason why this invention should not equally apply to locomotives/trains and/or the carriages comprising them be they surface trains or underground trains since the plate in these circumstances would be set between the rails and a suitable projection on each carriage would cause the plate to rock or move about its axis thereby generating energy. This would be particularly relevant on downward gradients without causing any significant disturbance or

sensation to the passengers. An approach ramp would enhance a degree of impact loading on the plate and cancel out any opposing movement by the train's suspension system. It will also be readily appreciated that in a country like Australia where very substantial distances exist between stations the ability to generate power by the forward motion of the train particularly on downward gradients would be of great value.

[0117] It will be readily understood that any form of plate particularly a movable plate as proposed in this application will be subject to the ingress of dust, dirt, water, oil etc and for this reason it is proposed to provide a complete seal over the entire mechanism by the utilization of preferably a elastomeric cover which may be of natural rubber or any suitable manmade alternative. Sufficient elasticity must be incorporated to allow adequate movement since in a further proposal it is possible that the plate referred to may project a small amount above the road surface but be allowed to travel to some degree below the road surface thereby minimizing the impact on a vehicle passing over it

[0118] Relating to the impact on the vehicle it will also be understood that since the plate in the present proposal is damped by the hydraulic/pneumatic system the resultant shock wave will be for all intents and purposes imperceptible. Reference should also be made to the fact that either cylinder may in the alternative be gas filled. In reference to the utilization of a pump or bellows for reducing pollution it will be also understood that a pipe or channel along the roadside may carry the fumes and pollution so collected to a remote site for burning or cleansing by other means.

[0119] In reference to reducing pollution it will readily be understood that the pure act of moving air does not reduce pollution. However in one convenient embodiment described it will be appreciated that the air pressure generated and the resultant air movement will result in new air coming in to take the place of the air moved thereby reducing the harmful effect by means of dilution of the pollution.

[0120] In yet a further convenient embodiment the plate mechanism may be utilized to drive a bellows or fan type mechanism or any other suitable mechanism to draw in or expel air from tunnels utilized for the carriage of traffic or from densely populated town locations where fumes have been caused to settle by gravitational influences.

1-9. (canceled)

10. Apparatus for converting kinetic energy into useable power comprising a frame arranged to be fixed in a vehicle running track, a plate moveably mounted to the frame and power converter coupled both to the plate and a power generator, the plate being arranged to act on the power converter to cause power to be generated, and characterized in that the track and plate are so disposed as to cause at least a part of a vehicle moving on the track to drop onto the plate.

11. Apparatus as claimed in claim 10 wherein the plate is disposed at a level below the track level.

12. Apparatus as claimed in claim 10 wherein there is provided a raised portion of the track immediately in front of the plate.

13. Apparatus as claimed in claim 11 wherein there is provided a raised portion of the track immediately in front of the plate.

14. Apparatus as claimed in claim 10 wherein the plate is pivotally mounted.

15. Apparatus as claimed in claim 14 wherein the plate is pivotally mounted between two ends in a running direction.

16. Apparatus as claimed in claim 14 wherein the plate is coupled to said converter, whereby the plate drives said generator in its at least downward stroke and recovery stroke.

17. Apparatus as claimed in claim 16 wherein said generator is driven by a spragging clutch in both the downward stroke and said recovery stroke.

18. Apparatus as claimed in claim 16 wherein said generator is driven by a double acting cylinder arrangement in both the downward stroke and said recovery stroke.

19. Apparatus as claimed in claim 11 wherein the plate is pivotally mounted.

20. Apparatus as claimed in claim 19 wherein the plate is pivotally mounted between two ends in a running direction.

21. Apparatus as claimed in claim 19 wherein the plate is coupled to said converter, whereby the plate drives said generator in its at least downward stroke and recovery stroke.

22. Apparatus as claimed in claim 21 wherein said generator is driven by a spragging clutch in both the downward stroke and said recovery stroke.

23. Apparatus as claimed in claim 21 wherein said generator is driven by a double acting cylinder arrangement in both the downward stroke and said recovery stroke.

24. Apparatus as claimed in claim 12 wherein the plate is pivotally mounted.

25. Apparatus as claimed in claim 24 wherein the plate is pivotally mounted between two ends in a running direction.

26. Apparatus as claimed in claim 24 wherein the plate is coupled to said converter whereby the plate drives said generator in its at least downward stroke and recovery stroke.

27. Apparatus as claimed in claim 26 wherein said generator is driven by a spragging clutch in both the downward stroke and said recovery stroke.

28. Apparatus as claimed in claim 26 wherein said generator is driven by a double acting cylinder arrangement in both the downward stroke and said recovery stroke.

29. A method of converting kinetic energy into useable power comprising a frame arranged to be fixed in a vehicle running track, a plate moveably mounted to the frame and power converter coupled both to the plate and a power generator, the plate being arranged to act on the power converter to cause power to be generated, and wherein the track and plate are so disposed as to cause at least a part of a vehicle moving on the track to drop onto the plate.

30. An apparatus for converting kinetic energy to useable power comprising:

- (a) a frame fixedly attached to a road;
- (b) a surface assembly having at least two plates, each plate comprising a first and second end, wherein said plates are pivotally connected at said first end about a central portion of said surface assembly and each plate is pivotally connected to the frame at said second end about an outer portion of said surface assembly; and
- (c) a power converter moveably connected to the central portion of said surface assembly, wherein said power converter is coupled to a power generator;
- (d) whereby a force imposed on said central portion of said surface assembly drives said power generator through said power converter.

31. The apparatus of claim 30, wherein said power converter is a double acting cylinder.

32. The apparatus of claim 30, wherein said power converter is a spragging clutch.

33. The apparatus of claim 30, wherein said power converter is a gear assembly.

34. The apparatus of claim 30, wherein said power converter is a cam mechanism.

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