on an outer circumference thereof, an alignment adjustment mechanism 2160 that rotatably holds a tire T with the tire T in contact with the simulated road surface in a predetermined posture, a torque generator 130 (slip rate control device) that generates torque to be applied to the tire T, and an inverter motor 2080 that rotationally drives the rotating drum 2010 and a casing of the torque generator 130.

[0086] The rotating drum 2010 is rotatably supported by a pair of bearings 2011a. A pulley 2012a is attached to an output shaft 80a of the inverter motor 80, and a pulley 2012b is attached to one shaft of the rotating drum 2010. The pulley 2012a and the pulley 2012b are connected by a drive belt 2015 (e.g., toothed belt). A pulley 2012c is attached to the other shaft of the rotating drum 2010 via a relay shaft 2013. The relay shaft 2013 is rotatably supported by a bearing 2011b near one end where the pulley is attached. The pulley 2012c is connected to a pulley 2012d by a drive belt 2016. The pulley 2012d is coaxially fixed to a pulley 2012e and is rotatably supported by a bearing 2011c (FIG. 12) together with the pulley 2012e. The pulley 2012e is connected to a later-described shaft part 131a of the casing 131 of the torque generator 130 by a drive belt 2017.

[0087] FIG. 13 is a diagram showing an internal structure of the torque generator 130. The torque generator 130 includes the casing 131, and the servomotor 150 and a reduction gear 133 fixed inside the casing 131. In the present embodiment, the servomotor 150 having the same configuration as that of the first embodiment is used. Cylindrical shaft parts 131a and 131b are formed at both ends of the casing 131 in an axial direction. The casing 131 is rotatably supported by bearings 2020 and 2030 at the shaft parts 131a and 131b. A pulley 2012f is attached to an outer circumference of the shaft part 131a at one end (right end side in FIG. 13).

[0088] The reduction gear 133 has an input shaft 133a and an output shaft 133b, and rotational motion input to the input shaft 133a is reduced and output to the output shaft 133b. The input shaft 133a of the reduction gear 133 is connected to the drive shaft 150a of the servomotor 150 by a coupling 134. The output shaft 133b of the reduction gear 133 is connected to the coupling shaft 135. It should be noted that the reduction gear 133 is optionally provided in the torque generator 130. The coupling shaft 135 may be directly connected to the drive shaft 150a of the servomotor 150 without providing the reduction gear 133 in the torque generator 130.

[0089] The coupling shaft 135 is passed through a hollow portion of the cylindrical shaft part 131a of the casing 131 and is rotatably supported by a pair of bearings 136 provided on the inner circumference of the shaft part 131a. A tip of the coupling shaft 135 protrudes from a tip of the shaft part 131a. The coupling shaft 135 protruding from the shaft part 131a is connected

3020 is repeatedly accelerated and decelerated, the supply of driving electric power from the servo amplifier 3850 to the servomotor 150 of the second drive section 3020 and the supply of regenerative electric power from the servomotor 150 of the second drive section 3020 to the servo amplifier 3850 are repeated.

[0117] Most of the regenerative electric power generated by each servomotor 150 is temporarily accumulated in a capacitor 3853 and then reused to drive the servomotors 150 in the first drive section 3010 and the second drive section 3020. Therefore, the electric power consumption from a primary power source 3810 used to drive the servomotors 150 is slightly reduced. The surplus of the regenerative electric power is converted into sinusoidal alternating current by a power regenerative converter 3851 and output to the primary power source via a reactor 3840, an electromagnetic switch 3830 and a circuit breaker 3820.

[0118] The torsion test device 3000 includes an electric actuator that provides the specimen W with rotational motion of predetermined rotation speed and torque, and a control unit C3. As shown in FIG. 17, the electric actuator of the torsion test device 3000 includes the servomotor 150, inverters (the inverters 3852), and a power regenerative converter (the power regenerative converter 3851), which is similar to the vibration test device 1000.

[0119] In the torsion test device 3000, the servo amplifier 3850, including the inverters 3852, is a drive device that is supplied with energy from a power source and controlled by the control unit C3 to supply driving electric power for causing the servomotor 150 to generate fluctuating torque to the servomotors 150. Furthermore, the power regenerative converter 3851 regenerates, among the energy regenerated from the servomotors 150, energy that is not consumed by the acceleration of the servomotors 150 when the control unit C3 controls the servo amplifier 3850 (the inverters 3852) to generate fluctuating torque in the servomotors 150 to the power source.

[0120] By being configured as described above, the torsion test device 3000 can effectively use the regenerative energy in the torsion test performed by applying fluctuating torque (rotational motion of predetermined rotation speed and torque) to the specimen W, thereby reducing electric power consumption for the test.

[0121] The torsion test device 3000 according to the third embodiment of the present invention described above performs rotational torsion tests on a transmission units for FR vehicles, but the present invention is not limited to the configuration of the basic example of the third embodiment described above, and devices for performing rotational torsion tests on other power transmission mechanisms are also included in the present invention.

the acceleration of the motors 10 when the control unit C3 controls the servo amplifier 3850 (the inverters 3852) to give the desired acceleration to the table 5240 to the power source.

[0168] By being configured as described above, the collision simulation test device 5000 can effectively use regenerative energy in a collision simulation test in which the specimen is given a desired acceleration to subject to an impact similar to that of an actual collision, thereby reducing the amount of electric power consumption required for the test.

[0169] The collision simulation test device 5000 of the present embodiment can also be used as an impact test device for evaluating durability and reliability against impact by applying strong impact waves to products and parts. The collision simulation test device 5000 of the present embodiment can also be used as a vibration test device that applies vibration to products and parts.

[0170] In the present embodiment, the electric actuator 100 is used for the electric actuators 5320 of the front drive section 5300 and the electric actuators 5420 of the rear drive section 5400, but the motor 10 may be used individually in place of the electric actuator 100. In particular, when the collision simulation test device 5000 of the present embodiment is used as a vibration test device, since acceleration and deceleration are repeated in a short cycle, the regenerative electric power accumulated in the capacitor 3853 is efficiently reused by the motor 10, and thus electric power consumption for the test can be reduced.

[0171] (Sixth Embodiment)

A multi-test device according to a sixth embodiment of the present invention described below is a test device capable of performing uniformity and dynamic balancing tests on tires. FIG. 27 is a side view showing a basic configuration of a uniformity and dynamic balance multi-test device 6000 (hereinafter referred to as a multi-test device 6000) of an embodiment of the present invention. FIG. 28 schematically shows a method for rotationally driving a spindle 6120 of the multi-test device 6000.

[0172] As shown in FIG. 27, the multi-test device 6000 is configured to hold a tire T between a lower rim 6010 and an upper rim 6020 from the top and bottom. More specifically, the multi-test device 6000 nips and holds the tire T between the lower rim 6010 and the upper rim 6020 by inserting a locking shaft 6300, to which the upper rim 6020 is fixed at the upper end, into the spindle 6120 and securing the locking shaft 6300.

[0173] In the uniformity test, a rotating drum 6030 provided on a side of spindle 6120. The rotating drum 6030 is an example of a rotating drum in contact with the tire. The rotating drum 6030 is mounted on a movable housing 6032 that can slide on rails 6031 extending in a direction

converter 4851 regenerates, among the energy regenerated from the motor 10, energy that is not consumed by the acceleration of the motor 10 to the power source when the controller C4 controls the servo amplifier 4850 (the inverter 4852) to cause the rotating body 7100 at the predetermined speed.

[0197] By being configured as described above, the balance measurement device 7000 can effectively use the regenerative energy in the dynamic balancing test of rotating bodies such as crankshafts, thereby reducing electric power consumption required for the test.

[0198] (Eighth Embodiment)

FIGS. 31, 32, and 33 are a perspective view, a side view, and a plan view, respectively, of a hedge trimmer 8000 according to an eighth embodiment of the present invention. In FIGS. 32 and 33, a later-described piston 8050 is shown in cross-sectional view. In FIG. 33, a later-described frame 8002 is not shown.

[0199] The hedge trimmer 8000 is a motorized farm equipment (i.e., electrical equipment) used for trimming hedges and trees. The hedge trimmer 8000 includes the frame 8002, an electric actuator 8100 according to an embodiment of the present invention, and a pair of blades 8060 (8060A, 8060B). The electric actuator 8100 is a linear actuator that generates linear motion in a direction of an axis line Ax, and causes a reciprocating linear motion of the blades 8060, as described below.

[0200] The hedge trimmer 8000 includes a cover covering an internal structure of the electric actuator 8100, for example a handle attached to the frame 8002 for holding the hedge trimmer 8000, and an operating section including, for example, operation buttons and operation switches for operating the hedge trimmer 8000 However, for convenience of explanation, these components are omitted from the illustration.

[0201] The frame 8002 has a base 8002a that supports the electric actuator 8100, and a rod 8002b that stands at one end of the base 8002a.

[0202] The electric actuator 8100 includes a motor 8010 (a drive part), a ball screw 8030 (a feed screw mechanism) which is a motion converter that converts power (rotational motion) output by the motor 8010 into linear motion, the piston 8050 (a linear motion part) driven by the ball screw 8030 in a direction of the axis line Ax, and a linear guide 8040 that supports the piston 8050 movably in the direction of the axis line Ax. The motor 8010 and the linear guide 8040 are attached to the base 8002a.

[0203] The motor 8010 is an electric motor of which rotation can be switched between forward and reverse rotations and is, for example, an ultra-low inertia and high output type AC

inverter device 97 is not needed because rectification of the electric power generated by the generator is not required. Therefore, for example, an output terminal of the direct current generator is connected to the direct current bus bar 97d without via the converter 97a.

[0231] The inverter device 97 may be provided with a battery, and the battery may be connected to the direct current bus bar 97d in parallel with the capacitor 97c.

[0232] A clutch may be provided between the generator 8080 and the motor 8010, and the timing of power absorption by the generator 8080 may be controlled by intermittency of the clutch.

[0233] The direct current bus bar 97d, the capacitor 97c, and the inverter 97b of the inverter device 97 may be shared with the direct current bus bar 95d, the capacitor 95c, and the power regenerative converter 95a of the servo amplifier 95, respectively.

[0234] (Eleventh Embodiment)

FIG. 36 is a block diagram showing a schematic configuration of an electric power feeding system 490 of an electric actuator according to an eleventh embodiment of the present invention.

[0235] The electric power feeding system 490 of the eleventh embodiment is an electric power feeding system obtained by adding the generator 8080 of the tenth embodiment in the electric power feeding system 290 of the nineth embodiment, and by further adopting a servo amplifier 495 obtained by incorporating the functions of the inverter device 97 of the tenth embodiment in the servo amplifier 295 (specifically, by adding the converter 97a of the tenth embodiment).

[0236] In the electric power feeding system 390 of the tenth embodiment, since the servo amplifier 95 and the inverter device 97 are separated and each connected to the primary power source 91, an interface with the primary power source 91 (the power regenerative converter 95a and the inverter 97b) and a direct current circuit (the direct current bus bars 95d and 97d, and the capacitors 95c and 97c) are provided separately. In contrast, in the electric power feeding system 490 of the eleventh embodiment (specifically, in the servo amplifier 495), the inverter 97b, the direct current bus bar 97d, and the capacitor 97c which are redundant are removed by integrating the servo amplifier 95 and the inverter device 97.

[0237] (Twelfth Embodiment)

FIGS. 37 and 38 are side and front views, respectively, of a hedge trimmer 9000 according to a twelfth embodiment of the present invention. In FIGS. 37 and 38, the pistons 8050 are shown in cross-sectional view. In FIG. 38, the frame 8002 is omitted.

[0238] While, in the hedge trimmer 8000 of the eighth embodiment described above, only one

wherein the electric actuator includes:

an electric motor of which rotation can be switched between forward and reverse rotations; and

a drive device that is supplied with electric power from a power source and controlled by the controller to supply driving electric power for vibrating the vibrating table at desired amplitude and frequency to the electric motor,

wherein the drive device includes a power regenerative converter that regenerates electric power that is not consumed by acceleration of the electric motor, among electric power regenerated from the electric motor when the vibrating table is vibrated at the desired amplitude and frequency, to the power source.

[Additional Note 22]

The vibration test device according to Additional Note 21, wherein:

the controller controls the drive device so that the electric motor repeats forward and reverse rotations at a required frequency during a drive period of the electric motor, and

the power regenerative converter outputs the electric power regenerated from the electric motor during deceleration period of the electric motor in the forward and reverse rotations, respectively, to the power source.

[Additional Note 23]

The vibration test device according to Additional Note 21, wherein:

among a forward rotation period and a reverse rotation period of the electric motor which are continuously repeated, the vibrating table moves in a forward direction during the forward rotation period, and the vibrating table moves in a reverse direction during the reverse rotation period,

the forward rotation period includes a first acceleration period of the electric motor that starts at the time when the vibrating table starts moving and a first deceleration period of the electric motor that ends when the vibrating table stops moving,

the reverse rotation period includes a second acceleration period of the electric motor that starts at the time when the vibrating table starts moving and a second deceleration period of the electric motor that ends at the time when the vibrating table stops moving, and

the controller:

accelerates the electric motor so that torque of the electric motor becomes positive during the first acceleration period;

decelerates the electric motor so that the torque of the electric motor becomes