CLAIMS

1. A vibration test device, comprising:

a vibrating table on which an object to be vibrated is to be attached;

an electric actuator that vibrates the vibrating table in a predetermined direction; and

a controller that controls the electric actuator,

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.

2. The vibration test device according to claim 1, 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 processes of the electric motor in the forward and reverse rotations, respectively, to the power source.

3. The vibration test device according to claim 1, wherein:

among a forward rotation period and a reverse rotation period of the electric motor which are continuously repeated in a drive period, 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 negative during the first deceleration period;

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

decelerates the electric motor so that the torque of the electric motor becomes negative during the second deceleration period.

4. The vibration test device according to claim 3, wherein:

the drive device further includes a capacitor provided between the power regenerative converter and the electric motor, and

the controller is configured to control the drive device so that energy regenerated from the electric motor and accumulated in the capacitor during the first deceleration period is supplied to the electric motor with priority over energy supplied from the power source during the second acceleration period, and energy regenerated from the electric motor and accumulated in the capacitor during the second deceleration period is supplied to the electric motor with priority over energy supplied from the power source during the first acceleration period.

5. The vibration test device according to claim 3, wherein:

the drive device further includes a capacitor provided between the power regenerative converter and the electric motor,

the controller repeats an energy cycle comprising the first acceleration period, the first deceleration period, the second acceleration period, and the second deceleration period in the drive period,

during the first acceleration period, at least energy accumulated in the capacitor during the second deceleration period of the previous energy cycle is supplied to the electric motor,

during the first deceleration period, energy regenerated from the electric motor is accumulated in the capacitor,

during the second acceleration period, at least energy accumulated in the capacitor

during the first deceleration period in the current energy cycle is supplied to the electric motor, and

during the second deceleration period, energy regenerated from the electric motor is accumulated in the capacitor.

6. The vibration test device according to claim 2,

wherein the controller controls the drive device so that the electric motor repeats forward and reverse rotations at a required frequency of 3Hz or higher during the drive period.

7. The vibration test device according to claim 1, wherein:

the power source comprises an alternating current power source, and

the power regenerative converter comprises a bidirectional ACDC converter.

8. The vibration test device according to claim 1, wherein:

the power source comprises a direct current power source, and

the power regenerative converter comprises a bidirectional DCDC converter.

9. A tire test device, comprising:

an electric actuator; and

a controller that controls the electric actuator,

wherein the electric actuator includes:

an electric motor having a rotary shaft to be connected to a central axis of a tire; and

a drive device that is supplied with energy from a power source and controlled by the controller to supply driving electric power for causing the electric motor to generate fluctuating torque to the electric motor,

wherein the drive device includes a power regenerative converter that regenerates energy that is not consumed by acceleration of the electric motor, among energy regenerated from the electric motor when the controller controls the drive device to cause the electric motor to generate the fluctuating torque, to the power source.

10. A torsion test device, comprising:

an electric actuator; and

a controller that controls the electric actuator,

wherein the electric actuator includes:

an electric motor having a rotary shaft to be connected to a specimen; and

a drive device that is supplied with energy from a power source and controlled by the controller to supply driving electric power for causing the electric motor to generate fluctuating torque to the electric motor,

wherein the drive device includes a power regenerative converter that regenerates energy that is not consumed by acceleration of the electric motor, among energy regenerated from the electric motor when the controller controls the drive device to cause the electric motor to generate the fluctuating torque, to the power source.

11. A tensile and compression test device, comprising:

an electric actuator; and

a controller that controls the electric actuator,

wherein the electric actuator includes:

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

a motion converter that performs reciprocating linear motion in response to the forward and reverse rotations of the electric motor;

a movable part that receives the reciprocating linear motion of the motion converter and transmits compressive or tensile force to a specimen; and

a drive device that is supplied with energy from a power source and controlled by the controller to supply driving electric power for causing the motion converter to perform the reciprocating linear motion at desired amplitude and frequency to the electric motor,

wherein the drive device includes a power regenerative converter that regenerates energy that is not consumed by acceleration of the electric motor, among energy regenerated from the electric motor when the controller controls the drive device to cause the motion converter to perform the reciprocating linear motion at the desired amplitude and frequency.

12. A dynamic balancing multi-test device, comprising:

a spindle to which a tire is to be mounted;

an electric actuator that outputs unidirectional rotary motion;

a transmission mechanism that transmits the unidirectional rotary motion to the spindle; and

a controller that controls the electric actuator,

wherein the electric actuator includes:

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

a motion converter that converts the forward and reverse rotations of the electric motor into a unidirectional rotary motion; and

a drive device that is supplied with energy from a power source and controlled by the controller to supply driving electric power for causing the spindle to rotate at a predetermined speed to the electric motor,

wherein the drive device includes a power regenerative converter that regenerates energy that is not consumed by the acceleration of the electric motor, among energy regenerated from the electric motor when the controller controls the drive device to cause the spindle to rotate at the predetermined speed.

13. A uniformity test device, comprising:

a rotating drum that contacts a tire,

an electric actuator that causes the rotating drum to perform a unidirectional rotary motion; and

a controller that controls the electric actuator,

wherein the electric actuator includes:

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

a motion converter that converts the forward and reverse rotations of the electric motor into a unidirectional rotary motion; and

a drive device that is supplied with energy from a power source and controlled by the controller to supply driving electric power for causing the rotating drum to rotate at a predetermined speed to the electric motor,

wherein the drive device includes a power regenerative converter that regenerates energy that is not consumed by acceleration of the electric motor, among energy regenerated from the electric motor when the controller controls the drive device to cause the rotating drum to rotate at the predetermined speed, to the power source.

14. A balance measurement device, comprising:

an electric actuator that outputs unidirectional rotary motion:

a transmission mechanism that transmits the unidirectional rotary motion to a specimen; and

a controller that controls the electric actuator,

wherein the electric actuator includes:

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

a motion converter that converts the forward and reverse rotations of the electric motor into the unidirectional rotary motion; and

a drive device that is supplied with energy from a power source and controlled by the controller to supply driving electric power for causing the specimen to rotate at a predetermined speed to the electric motor,

wherein the drive device includes a power regenerative converter that regenerates energy that is not consumed by acceleration of the electric motor, among energy regenerated from the electric motor when the controller controls the drive unit to rotate the specimen at the predetermined speed, to the power source.

15. A collision simulation test device, comprising:

an attachment part to which a specimen is to be attached;

an electric actuator that outputs unidirectional rotary motion;

a transmission mechanism that converts the unidirectional rotary motion into linear motion and transmits the linear motion to the attachment part; and

a controller that controls the electric actuator,

wherein the electric actuator includes:

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

a motion converter that converts the forward and reverse rotations of the electric motor into unidirectional rotary motion; and

a drive device that is supplied with energy from a power source and controlled by the controller to supply driving electric power for providing a desired acceleration to the attachment part to the electric motor,

wherein the drive device includes a power regenerative converter that regenerates energy that is not consumed by acceleration of the electric motor, among energy regenerated from the electric motor when the controller controls the drive device to provide the desired acceleration to the attachment part, to the power source.

16. A hedge trimmer, comprising:

a blade;

an electric actuator that causes the blade to perform a reciprocating linear motion; and

a controller that controls the electric actuator,

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 energy from a power source and controlled by said controller to supply driving electric power for causing the blade to perform the reciprocating linear motion to the electric motor,

wherein the drive device includes a power regenerative converter that regenerates energy that is not consumed by acceleration of the electric motor, among energy regenerated from the electric motor when the controller controls the drive device to cause said blade to perform the reciprocating linear motion, to the power source.