CLAIMS

[Claim 1] A spherical lens surface processing method, the method including the steps of:

forming a contact state in which a rotating cup-shaped grinding stone is brought into contact at a predetermined pressure with a lens surface of a glass lens to be processed; and

while maintaining the contact state, forming a state of sphere center oscillation in which the cup-shaped grinding stone oscillates along the lens surface centered on a sphere center as an oscillation center, and grinding the lens surface to a spherical surface having a predetermined surface precision and center thickness;

wherein, in the state of sphere center oscillation,

a distance from the oscillation center to a contact point where the cup-shaped grinding stone makes contact with the lens surface is set to be equal to a radius of the sphere surface; and

when a cross-sectional plane is envisioned, which is a cross-section of the lens and the cup-shaped grinding stone cut along a vertical plane including the lens center axis and the grinding stone center axis,

an oscillation range of the spherical center oscillation is set so that, in the cross-sectional plane, an edge end on one side of the cup-shaped grinding stone that contacts the lens surface moves past a lens center along the lens surface, and that an

edge end on the other side of the cup-shaped grinding stone that contacts the lens surface moves from the lens surface to a position off an outer peripheral edge of the lens surface.

[Claim 2] The spherical lens surface processing method according to claim 1,

wherein the lens is forcibly rotated at a lesser speed than the cup-shaped grinding stone; and

a forced rotation state of the lens is ceased when a torque exerted on the lens by a frictional force between the lens surface and the cup-shaped grinding stone creates a passively rotatable state in which the lens can rotate passively following the cup-shaped grinding stone at a speed greater than a forced rotation speed of the lens, the cup-shaped grinding stone being in the state of sphere center oscillation.

[Claim 3] The spherical lens surface processing method according to claim 1,

wherein the lens, which is in contact with the cup-shaped grinding stone, is supported by an elastic stretching member; and

the cup-shaped grinding stone and the lens are maintained in the contact state by an elastic force produced by stretching of the elastic stretching member.

[Claim 4] The spherical lens surface processing method according to

claim 1,

wherein the contact state is formed in a state in which lens is held with vacuum suction by a lens holder.

[Claim 5] A spherical lens surface processing apparatus, comprising:

a cup-shaped grinding stone;

a grinding stone rotation mechanism for rotating the cup-shaped grinding stone about a central axis thereof;

a lens holder for holding a lens to be processed;

a lens movement mechanism for moves the lens held in the lens holder so that a lens surface of the lens moves in directions towards and away from the cup-shaped grinding stone;

a sphere center oscillation mechanism for causing the cup-shaped grinding stone to oscillate centered on a sphere center as an oscillation center along the lens surface of the lens held in the lens holder; and

a controller for controlling the grinding stone rotation mechanism, the lens movement mechanism, and the sphere center oscillation mechanism,

wherein the controller has the functions of:

forming a contact state in which the cup-shaped grinding stone while rotating is brought into contact with the lens surface at a predetermined pressure;

while maintaining the contact state, forming a sphere center oscillation state in which the cup-shaped grinding stone oscillates along the lens surface centered on the sphere center, and grinding the lens

surface to a spherical surface having a predetermined surface precision and center thickness;

in the sphere center oscillation state, setting a distance to be equal to a radius of the spherical surface, the distance being from an oscillation center of the sphere center oscillation to a contact point where the cup-shaped grinding stone makes contact with the lens surface; and

when a cross-sectional plane is envisioned, which is a cross-section of the lens and the cup-shaped grinding stone cut along a vertical plane including the lens center axis and the grinding stone center axis,

setting an oscillation range of the spherical center oscillation so that, in the cross-sectional plane, an edge end on one side of the cup-shaped grinding stone that contacts the lens surface moves past a lens center along the lens surface, and that an edge end on the other side of the cup-shaped grinding stone that contacts the lens surface moves from the lens surface to a position off an outer peripheral edge of the lens surface.

[Claim 6] The spherical lens surface processing apparatus according to claim 5, further comprising:

a forced rotation mechanism for forcibly rotating the lens holder about a central axis thereof; and

a one-way clutch configured so as to cease forced rotation of the lens caused by the forced rotation mechanism,

wherein the controller further has the function of:

forcibly causing the lens to rotate at a lesser speed than the cup-shaped grinding stone, and

wherein the one-way clutch is set so as to cease the forced rotation of the lens when a torque exerted on the lens by a frictional force between the lens surface and the cup-shaped grinding stone creates a passively rotatable state in which the lens can rotate passively following the cup-shaped grinding stone at a speed greater than the forced rotation speed, the cup-shaped grinding stone being in the sphere center oscillating state.

[Claim 7] The spherical lens surface processing apparatus according to claim 5, further comprising:

an elastic stretching member for supporting the lens holder from a direction along a holder central axis, and for bringing the lens surface of the lens held in the lens holder into contact with the cup-shaped grinding stone at a predetermined force.

[Claim 8] The spherical lens surface processing apparatus according to claim 5, further comprising:

a vacuum suction-holding mechanism,

wherein the lens holder is configured so as to hold the lens through vacuum suction-holding force provided by the vacuum suction-holding mechanism.

[Claim 9] A spherical lens surface processing apparatus, comprising:

a cup-shaped grinding stone;

a grinding stone rotation mechanism for rotating the cup-shaped grinding stone about a central axis thereof;

a lens holder for holding a lens to be processed;

a lens movement mechanism for moves the lens held in the lens holder so that a lens surface of the lens moves in directions towards and away from the cup-shaped grinding stone;

a forced rotation mechanism for forcibly rotating the lens holder about a central axis thereof;

a one-way clutch configured so as to cease forced rotation of the lens caused by the forced rotation mechanism,

an elastic stretching member for supporting the lens holder from a direction along a holder central axis, and for bringing the lens surface of the lens held in the lens holder into contact with the cup-shaped grinding stone at a predetermined force;

a sphere center oscillation mechanism for causing the cup-shaped grinding stone to oscillate centered on a sphere center as an oscillation center along the lens surface of the lens held in the lens holder; and

a controller for controlling the grinding stone rotation mechanism, the lens movement mechanism, and the sphere center oscillation mechanism,

wherein the controller has the functions of:

forming a contact state in which the cup-shaped grinding stone while rotating is brought into contact with the lens surface at a predetermined pressure;

while maintaining the contact state, forming a sphere center oscillation state in which the cup-shaped grinding stone oscillates along the lens surface centered on the sphere center, and grinding the lens surface to a spherical surface having a predetermined surface precision and center thickness;

in the sphere center oscillation state, setting a distance to be equal to a radius of the spherical surface, the distance being from the oscillation center of the sphere center oscillation to a contact point where the cup-shaped grinding stone makes contact with the lens surface; and

when a cross-sectional plane is envisioned, which is a cross-section of the lens and the cup-shaped grinding stone cut along a vertical plane including the lens center axis and the grinding stone center axis,

setting an oscillation range of the spherical center oscillation so that, in the cross-sectional plane, an edge end on one side of the cup-shaped grinding stone that contacts the lens surface moves past a lens center along the lens surface, and that an edge end on the other side of the cup-shaped grinding stone that contacts the lens surface moves from the lens surface to a position off an outer peripheral edge of the lens surface.