CLAIMS

[Claim 1] A polishing apparatus comprising:

a polishing table configured to support a polishing pad;

a polishing head configured to press a workpiece against a polishing surface of the polishing pad;

a dresser configured to dress the polishing surface of the polishing pad;

a detection sensor configured to detect friction between the dresser and the polishing pad, the detection sensor being fixed to the dresser; and

a wear monitoring device configured to determine a wear index value from a plurality of output values of the detection sensor and generate an alarm signal when the wear index value is smaller than below a predetermined lower limit~~.~~,

wherein the wear monitoring device is configured to apply Fourier transform to the plurality of output values arranged along a time axis to create a power spectrum, and

determine the wear index value which is a first peak value of the power spectrum.

~~[Claim 2] The polishing apparatus according to claim 1, wherein the wear monitoring device is configured to perform a frequency analysis on the plurality of output values arranged along a time axis to determine the wear index value.~~

~~[Claim 3] The polishing apparatus according to claim 2, wherein:~~

~~the frequency analysis is a Fourier transform;~~

~~the wear monitoring device is configured to apply the Fourier transform to the plurality of output values arranged along the time axis to create a power spectrum; and~~

~~the wear index value is a first peak value of the power spectrum.~~

[Claim ~~4~~ 2] ~~The polishing apparatus according to claim 2,~~ A polishing apparatus comprising:

a polishing table configured to support a polishing pad;

a polishing head configured to press a workpiece against a polishing surface of the polishing pad;

a dresser configured to dress the polishing surface of the polishing pad;

a detection sensor configured to detect friction between the dresser and the polishing pad, the detection sensor being fixed to the dresser; and

a wear monitoring device configured to determine a wear index value from a plurality of output values of the detection sensor and generate an alarm signal when the wear index value is smaller than below a predetermined lower limit,

wherein the wear monitoring device is configured to calculate a plurality of relative output values by subtracting the plurality of output values from a plurality of reference values, respectively, ~~and~~ apply Fourier transform to ~~perform the frequency analysis on~~ the plurality of relative output values arranged along a time axis to create a power spectrum, and determine the wear index value which is a first peak value of the power spectrum.

~~[Claim 5] The polishing apparatus according to claim 4, wherein:~~

~~the frequency analysis is a Fourier transform;~~

~~the wear monitoring device is configured to apply the Fourier transform to the plurality of relative output values arranged along the time axis to create a power spectrum; and~~

~~the wear index value is a first peak value of the power spectrum.~~

[Claim ~~6~~ 3] The polishing apparatus according to claim ~~4 or 5~~ 2, wherein the plurality of reference values are a plurality of output values of the detection sensor obtained when the dresser dressed the polishing pad for the first time.

[Claim ~~7~~ 4] The polishing according to claim ~~3~~1 or ~~5~~ 2, wherein the wear monitoring device is configured to detect abnormality of the polishing pad when a second

peak value of the power spectrum is larger than a predetermined upper limit.

[Claim ~~8~~ 5] The polishing apparatus according to any one of claims 1 to ~~7~~ 4, wherein the detection sensor comprises one of an acceleration sensor, an acoustic emission sensor, and a strain sensor.

[Claim ~~9~~ 6] The polishing apparatus according to any one of claims 1 to ~~8~~ 5, further comprising:

a polishing progress detector configured to generate a polishing index value indicating progress of polishing of the workpiece; and

an operation controller configured to monitor the polishing index value, the operation controller being configured to correct the polishing index value based on the wear index value.

[Claim ~~10~~ 7] A method of determining a time to replace a polishing pad used in a polishing apparatus for a workpiece, comprising:

detecting friction between a dresser and the polishing pad by a detection sensor fixed to the dresser while dressing a polishing surface of the polishing pad by the dresser;

~~determining a wear index value from a plurality of output values of the detection sensor; and~~

applying Fourier transform to a plurality of output values of the detection sensor arranged along a time axis to create a power spectrum;

determining a wear index value which is a first peak value of the power spectrum; and

generating an alarm signal when the wear index value is smaller than a predetermined lower limit.

~~[Claim 11] The method according to claim 10, wherein determining the wear index~~

~~value comprises performing a frequency analysis on the plurality of output values arranged along a time axis to determine the wear index value.~~

~~[Claim 12] The method according to claim 11, wherein:~~

~~the frequency analysis is a Fourier transform; and~~

~~determining the wear index value comprises applying the Fourier transform to the plurality of output values arranged along the time axis to create a power spectrum, and determining the wear index value which is a first peak value of the power spectrum.~~

[Claim ~~13~~ 8] ~~The method according to claim 11,~~ A method of determining a time to replace a polishing pad used in a polishing apparatus for a workpiece, comprising:

detecting friction between a dresser and the polishing pad by a detection sensor fixed to the dresser while dressing a polishing surface of the polishing pad by the dresser;

~~wherein determining the wear index value comprises~~ calculating a plurality of relative output values by subtracting ~~the~~ a plurality of output values of the detection sensor from a plurality of reference values, respectively, and ~~performing the frequency analysis on~~ applying Fourier transform to the plurality of relative output values arranged along ~~the~~ a time axis to create a power spectrum;

determine ~~the~~ a wear index value which is a first peak value of the power spectrum; and

generating an alarm signal when the wear index value is smaller than a predetermined lower limit.

~~[Claim 14] The method according to claim 13, wherein:~~

~~the frequency analysis is a Fourier transform; and~~

~~determining the wear index value comprises applying the Fourier transform to the plurality of relative output values arranged along the time axis to create a power spectrum, and determining the wear index value which is a first peak value of the power~~

~~spectrum.~~

[Claim ~~15~~ 9] The method according to claim ~~13 or 14~~ 8, wherein the plurality of reference values are a plurality of output values of the detection sensor obtained when the dresser dressed the polishing pad for the first time.

[Claim ~~16~~ 10] The method according to claim ~~12~~7 or ~~14~~ 8, further comprising detecting abnormality of the polishing pad when a second peak value of the power spectrum is larger than a predetermined upper limit.

[Claim ~~17~~ 11] The method according to any one of claims ~~10~~7 to ~~16~~ 10, wherein the detection sensor is one of an acceleration sensor, an acoustic emission sensor, and a strain sensor.

[Claim ~~18~~ 12] The method according to any one of claims ~~10~~7 to ~~17~~11, further comprising correcting a polishing index value indicating progress of polishing of the workpiece based on the wear index value.