What is claimed is:

1. A pad-temperature regulating apparatus for regulating a surface temperature of a polishing pad to a predetermined target temperature, comprising:

a heat exchanger disposed above the polishing pad in a non-contact manner, whose temperature is maintained at a predetermined temperature;

a pad-temperature measuring device configured to measure the surface temperature of the polishing pad;

a distance sensor configured to measure a separation distance between the polishing pad and the heat exchanger, and mounted on an outer surface of the heat exchanger;

an elevating mechanism for moving the heat exchanger vertically with respect to the polishing pad; and

a controller configured to control operation of the elevating mechanism based on measured values of the pad-temperature measuring device, and measured values of the distance sensor.

2. The pad-temperature regulating apparatus according to claim 1, wherein the heat exchanger includes a heating flow passage formed therein, and

the heating flow passage is supplied with a heating liquid, whose temperature is maintained at a predetermined temperature, at a predetermined flow rate.

3. The pad-temperature regulating apparatus according to claim 1 or 2, further comprising a cooling mechanism for cooling the surface of the polishing pad,

wherein the controller operates the cooling mechanism when the target temperature is lower than the measured value of the pad-temperature measuring device after the elevating mechanism reaches an upper limit of movement of the heat exchanger.

4. The pad-temperature regulating apparatus according to claim 3, wherein the

cooling mechanism includes a cooling flow passage formed in the heat exchanger, into which a cooling liquid is supplied, and

the controller controls a flow rate of the cooling liquid based on the measured values of the pad-temperature measuring device.

5. The pad-temperature regulating apparatus according to any one of claims 1 through 4, wherein the controller includes:

a memory which stores a learned model constructed by machine learning using training data including at least a combination of the distance between the heat exchanger and the polishing pad, and the temperature of the surface of the polishing pad corresponding to the distance; and

a processing device for operating to input temperature control parameters which include at least the target temperature and the measured value of the pad-temperature measuring device into the learned model, and to output an amount of operation of the elevating mechanism.

6. A pad-temperature regulating method for regulating a surface temperature of a polishing pad to a predetermined target temperature, comprising:

measuring the surface temperature of the polishing pad by use of a pad-temperature measuring device;

measuring a separation distance between the polishing pad and a heat exchanger, which is disposed above the polishing pad, and whose temperature is maintained at a predetermined temperature, by use of a distance sensor mounted on an outer surface of the heat exchanger; and

moving the heat exchanger, which is disposed above the polishing pad in a non-contact manner, and whose temperature is maintained at a predetermined temperature, vertically with respect to the polishing pad based on measured values of the pad-temperature measuring device, and measured values of the distance sensor to thereby regulating the

surface temperature of the polishing pad to the target temperature.

7. The pad-temperature regulating method according to claim 6, wherein, in order to maintain the heat exchanger at the predetermined temperature, a heating liquid, whose temperature is maintained at a predetermined temperature, is supplied at a predetermined flow rate to a heating flow passage formed in the heat exchanger.

8. The pad-temperature regulating method according to claim 6 or 7, wherein a cooling mechanism is used to cool the surface of the polishing pad when, after the heat exchanger reaches an upper limit of movement, the target temperature is lower than the measured value of the pad-temperature measuring device.

9. The pad-temperature regulating method according to claim 8, wherein cooling of the surface of the polishing pad is controlling of a flow rate of cooling liquid flowing through a cooling flow passage formed in the heat exchanger based on measured values of the pad-temperature measuring device.

10. The pad-temperature regulating method according to any one of claims 6 through 9, wherein a learned model is constructed by machine learning using training data including at least a combination of a distance between the heat exchanger and the polishing pad, and a temperature of the surface of the polishing pad corresponding to the distance, and

temperature control parameters, which include at least the target temperature and the measured value of the pad-temperature measuring device, are input to the learned model to output an amount of operation of the elevating mechanism.

11. A polishing apparatus, comprising:

a polishing table supporting a polishing pad;

a polishing head for pressing a substrate against the polishing pad;

a pad-temperature measuring device for measuring a surface temperature of the polishing pad; and

a pad-temperature regulating apparatus according to any one of claims 1 through 5.