In operation, by way of example, between boiler loads of 100% and 60%, the adjustable damper **72** position is 0% open and the FGR flow control device **20** is in normal mode as the boiler flue gas flow and temperature sufficiently maintains the CFB **10** inlet flow rate and temp at a predetermined minimum setpoint (the latter nominally being 240° F. for a typical coal fired boiler application) without use of FGR. As the load drops below 60% and the scrubber inlet temperature drops below 240° F. the adjustable damper **72** is opened to 20% position, introducing 20% preheated recirculated flue gas flow, and the FGR flow control device **20** is in preheat mode to elevate the CFB **10** inlet temperature back to 240° F.

The present invention also encompasses a pre-heater assembly **90** in which the pre-heater **92** is connected inline in series along a section of the FGR duct **30** proximate the CFB **10** inlet, with isolation dampers **94***a*, **94***b* and **94***c* excluded. However, there is an advantage to having the pre-heater in parallel with the main FGR duct **30** because the pre-heater **92** adds pressure drop to the duct which decreases its effectiveness. Also, having the pre-heater **92** exposed to the flue gases even during times when heat is not required would shorten its service life due to corrosion and other factors. Placing the pre-heater **92** in a separate duct in parallel allows purging of the heater area with clean air or gas to prevent corrosion. In the case of multiple AQC systems **8** it is also possible, by placing the FGR duct **30** in a parallel and not serial mode, to place one pre-heater assembly **90** in parallel with the FGR ducts **30** of both AQC systems **8** and to allow sharing of the single pre-heater assembly **90** simply by adding a second set of bypass dampers **94***a* and **94***b*.

The above-described AQCS system is premised on an existing incoming flow of flue gas that is not at the right temperature or flow. However, the AQCS system **8** has the capability to be placed completely in service with no boiler flue gas flow at all, instead substituting preheated recirculation flow to satisfy the need for the CFB **10** inlet temperature to be high enough to promote the acid gas reactions with lime in the reactor chamber and avoiding excursions during low-load operation. In situations where there is no incoming flue gas at all, it becomes necessary to add an isolation damper in the duct coming from the boiler at a point upstream of the gas recirculation exit from **90**. Also a damper needs to be added downstream of the ID Fan outlet duct **33** and FGR duct **30** junction. The first isolation damper **99** and second isolation damper **100**, respectively, are shown in dotted lines. These dampers **99**, **100** serve both as flow control and isolation dampers. They remain fully closed without flue gas so that ambient air is recycled through the heater section in a closed loop. This will cause the air to increase in temperature with time and will also establish minimum flow. When this preflow is increased up to the requisite flow setpoint the lime, fuel ash and byproduct can be added into CFB Scrubber **10** to create a fluidized bed. When it is increased up to the temperature setpoint water can be added. This was previously impossible since without the preheating this is impossible (even with isolation dampers **99** and **100**). At this point the CFB scrubber **100** is now fully in service and the dampers **99** and **100** can be opened to allow flue entry. The flow control system **20** and temperature control system **90** will then automatically react the flow and temperature of the incoming gas, maintaining both as needed.

The above-described invention is equally well-suited for use in an AQCS comprising a spray dryer absorber (SDA) or Transport Reactor (TR) in combination with a flue gas recirculation FGR loop, and the very same preflow construct with dampers **99**, **100** can be used with any of the SDA, TR and CFB scrubbers as described below.

FIG. **2** is a diagram of an alternative embodiment of the invention incorporated in an Air Quality Control System AQCS comprising a spray dryer absorber SDA in combination with a flue gas recirculation FGR loop. In spray dryer absorber SDA **9** flue gas is contacted with an aqueous lime slurry that is sprayed onto the flue gas, SDA **9** being connected to a downstream particulate removal device **12**. The SDA scrubber **10** is a well-established dry scrubber used widely for boilers burning a wide range of fuels including coal bituminous, sub-bituminous and PRB, pet coke, peat and biomass. Again, optional dampers **99**, **100** (dotted lines) can be used as described above to place the AQCS system completely in service with no boiler flue gas flow at all, instead substituting preheated recirculation flow to satisfy the need for the SDA **9**. All other components and operation of the present invention are as described above in regard to FIG. **1**.

FIG. **3** is a diagram of yet another alternative embodiment of the invention incorporated in an Air Quality Control System AQCS comprising a Transport Reactor (TR) **11** in combination with a flue gas recirculation FGR loop. TR **11** is connected to a downstream particulate removal device **12**. The TR **11** is a well-established dry scrubber, an example being the Alstom™ Flash Dryer Absorber (FDA) system, also known as the Alstom™ Novel Integrated Desulphurization System (NIDS). All other components and operation of the present invention are as described above in regard to FIGS. **1-2**. Again, optional dampers **99**, **100** (dotted lines) can be used as described above to place the AQCS system completely in service with no boiler flue gas flow at all, instead substituting preheated recirculation flow to satisfy the need for the TR **11**. Note that in the case of the Transport Reactor FIG. **3** indicates an FGR loop around a single TR **11** and particulate removal device **12**.

The FGR design as contemplated is also applicable where multiple trains of TR **11** and particulate removal device **12** are in parallel, with an FGR system taking flue gas from a combined gas outlet downstream of the parallel particulate removal devices **12** and injecting the appropriate portion of it upstream of a common inlet upstream of the parallel TR **11** vessels.

It should now be apparent that the method and system of the present invention independently controls the inlet temperature and flow rate of a spray dryer absorber SDA, Transport Reactor TR and/or CFB in an Air Quality Control System AQCS additionally incorporating flue gas recirculation FGR within a pre-determined range of acceptable temperatures by automatically pre-heating flue gas recirculated to the input of the SDA/TR/CFB during periods of low temperature to ensure the total evaporation of the lime slurry or water mixture regardless of system load.

Having now fully set forth the preferred embodiments and certain modifications of the concept underlying the present invention, various other embodiments as well as certain variations and modifications thereto may obviously occur to those skilled in the art upon becoming familiar with the underlying concept. It is to be understood, therefore, that the invention may be practiced otherwise than as specifically set forth herein.

The invention claimed is:

1. An apparatus for automated inlet temperature control of an air quality control system including any one from among the group consisting of a circulating fluidized bed (CFB) scrubber, Transport Reactor (TR) or spray dryer absorber (SDA) scrubber with an inlet duct and an outlet duct connected to a downstream induced draft (ID) fan, air quality control system also including a flue gas recirculation (FGR)