Accordingly, an optimum apparatus to patients is chosen and supplied for use from various equipments including a low flow rate-type apparatus with a maximum possible supply flow rate of 2 L/min, 3 L/min and the like and a high flow rate-type apparatus with a maximum possible supply flow rate of 5 L/min, 7 L/min and 10 L/min and the like.

While the maximum supply flow rate of the apparatus is the value described above, an actual supply flow rate of oxygen clinically used can be generally set at a low flow rate of 0.25 L/min, 0.5 L/min and the like. In this case, where oxygen is generated at the maximum predetermined flow rate even if a prescribed flow rate is low, oxygen is wastefully generated and consuming more electric power. This leads to an effort to reduce electric power consumption in many apparatuses by an inverter control of a driving motor for a compressor to reduce a volume of raw material air to be supplied from the compressor to an adsorption bed.

When an attempt is made to secure a volume of raw material air required to supply concentrated oxygen in a high flow rate setting zone in a high flow rate-type apparatus, a volume of raw material air becomes excessive in a low flow rate setting zone to result in excess supply of the raw material. This leads to adsorption of part of oxygen in raw material air on the adsorbents to concentrate unadsorbed argon in the gas generated, as a result, an oxygen concentration in the oxygen concentrated gas generated is reduced.

A method of reducing a volume of raw material air supplied by lowering the number of revolution of a compressor is applied, but there exist such problems that as a control range in the number of revolution of the compressor is limited, and that its operation becomes unstable when a range in the number of revolution used is too low.

Various embodiments seek~~An object of the present invention is~~ to solve the problems described above and to provide an oxygen concentrator having both functions, of which electric power consumption of the apparatus is reduced and an oxygen concentration in a low flow rate

setting zone of an oxygen flow rate supplied from the oxygen concentrator is kept constant.

According to a first aspect, there is provided a pressure swing adsorption-type oxygen concentrator including:

at least one adsorption bed filled with an adsorbent capable of selectively adsorbing nitrogen relative to oxygen,

an air supply device to supply compressed air to the adsorption bed,

a flow channel switching device set up between the air supply device and the adsorption bed, to repeat at a predetermined timing an adsorption step to supply air from the air supply device to the adsorption bed to isolate concentrated oxygen and a desorption step to depressurize the adsorption bed to regenerate the adsorbent therein,

a flow rate setting device for setting the volume flow rate of concentrated oxygen supplied to a user, and

a control device for controlling the volume flow rate of compressed air supplied from the air supply device to be at a certain lower operation limit value to allow stable operation of the air supply device and a volume flow rate of compressed air released to an exhaust side through the flow channel switching device, each when the flow rate setting device is equal to or below a given setting value, and otherwise for controlling the volume flow rate of compressed air supplied from the air supply device based on the setting of the flow rate setting device, by controlling a switching timing of the flow channel switching device that determines a release volume of compressed air immediately before completion of an adsorption step, based on a predetermined value in the flow rate setting device, and to release a part of compressed air that is to be supplied to the adsorption bed immediately before the completion of the adsorption step.

That is, the present disclosure~~invention~~ provides an oxygen concentrator that is a pressure swing adsorption-type oxygen concentrator equipped with

at least one adsorption bed filled with an adsorbent capable of selectively adsorbing nitrogen relative to oxygen,

an air supply device to supply compressed air to the adsorption bed,

a flow channel switching device to repeat at a predetermined timing an adsorption step to supply air from the air supply device to the adsorption bed to isolate concentrated oxygen and a desorption step to depressurize the adsorption bed to regenerate the adsorbent therein, and

a flow rate setting device to set a volume of concentrated oxygen supplied to a user,

comprising an exhaust pipe channel equipped with a leak valve in a flow channel between the air supply device and the adsorption bed to release a part of compressed air that is to be supplied to the adsorption bed into atmosphere.

The present disclosure~~invention~~ also provides the oxygen concentrator comprising a control device to control an air supply volume from the air supply device based on a predetermined flow rate in the flow rate setting device, the air supply volume from the air supply device at a certain value when the predetermined flow rate is equal to or below a given flow rate, and a release volume of compressed air through the leak valve as determined based on the predetermined flow rate.

The present disclosure~~invention~~ also provides the oxygen concentrator, wherein the exhaust pipe channel is branched from a pipe channel connecting the air supply device and the channel switching device and equipped with a flow rate control valve as the leak valve, and wherein

the air supply device is a compressor with an inverter and

the control device is to control the number of revolution of a compressor based on a predetermined value in the flow rate setting device, the number of revolution of the compressor at a certain value when a predetermined flow rate is equal to or below a given flow rate, and an open/shut operation of the leak valve to release from the exhaust pipe channel a certain release volume determined based on a predetermined value in the flow rate setting device.

The present disclosure~~invention~~ also provides an oxygen concentrator that is a pressure swing adsorption-type oxygen concentrator equipped with

at least one adsorption bed filled with an adsorbent capable of selectively adsorbing nitrogen relative to oxygen,

an air supply device to supply compressed air to the adsorption bed,

a flow channel switching device to repeat at a predetermined timing an adsorption step to supply air from the air supply device to the adsorption bed to isolate concentrated oxygen and a desorption step to depressurize the adsorption bed to regenerate the adsorbent therein, and

a flow rate setting device to set a volume of concentrated oxygen supplied to a user,

comprising an air release function to release a part of compressed air that is to be supplied to the adsorption bed immediately before the completion of the adsorption step.

The present disclosure~~invention~~ also provides the oxygen concentrator, wherein the flow channel switching device is equipped with

a two-way electromagnetic valve (a) installed on a compressed air supply pipe connecting the air supply device and the adsorption bed,

a branch pipe channel in the adsorption bed and an exhaust side installed in a downstream side of the two-way electromagnetic valve (a) and

a two-way electromagnetic valve (b) installed on the branch pipe channel in the release

side.

The present disclosure~~invention~~ also provides the oxygen concentrator, wherein

the adsorption bed is composed of two adsorption beds and

the flow channel switching device is equipped with

a branch pipe channel connecting the air supply device and each adsorption bed to supply compressed air,

two-way electromagnetic valves (a1 and a2) installed on each branch pipe channel,

a branch pipe channel in the adsorption bed and an exhaust side installed in a downstream side of the two-way electromagnetic valves (a1 and a2),

two-way electromagnetic valves (b1 and b2) installed on each branch pipe channel in the exhaust side and

a branch pipe channel connecting an exhaust outlet and the two-way electromagnetic valves (b1 and b2);

comprising a control device to control a switching timing of the flow channel switching device that determines a release volume of compressed air immediately before completion of an adsorption step, based on a predetermined value in a flow rate setting device.

Brief Description of Drawings

Figure 1 is a schematic diagram of a pressure swing adsorption-type oxygen concentrator in an example of illustrative embodiment in the present invention.

Figure 2 is a diagram to demonstrate a relation of a concentration of oxygen generated with a supply volume of raw material air required for a predetermined flow rate in a conventional oxygen concentrator. A-A' represents a range of an airflow volume suppliable with a compressor and A' represents a lower limit of an airflow volume suppliable with a compressor.