suggested that the bottom hole pressure can be controlled using this valve. Controlling the bottom hole pressure in this way, whilst theoretically possible, would be very difficult to achieve in practice, at least to any degree of accuracy and within a reasonable timescale. Opening the back pressure control valve not only has the effect of increasing the back-pressure in the return line, but also decreasing the pressure of mud entering the drill pipe, and this combined effect means that the effect of opening the valve is not straightforward to predict and, it is likely that numerous iterations and adjustments of the back pressure control valve would be required to achieve the desired bottom hole pressure.

According to an aspect of the invention, there is provided a method of drilling a borehole using a drilling system including a control apparatus, the control apparatus having an inlet, a main outlet and an overflow outlet, the inlet being connected to the main outlet by a main flow conduit and the overflow outlet being connected to the main conduit by an overflow conduit, the overflow conduit being provided with a pressure regulator, the drilling system further including a drill pipe connected to the main outlet of the control apparatus, a pump connected the inlet of the control apparatus, and a fluid reservoir connected to the overflow outlet, wherein the method includes the steps of operating the pump to pump fluid into the drill pipe via the main flow conduit of the control apparatus, and operating the pressure regulator to maintain the pressure of fluid in the main flow conduit at or around a predetermined level, while drilling the borehole.

There is disclosed~~According to a first aspect of the invention we provide~~ a control system for use in controlling the fluid pressure in a borehole during drilling of the borehole, the system including an inlet suitable for connection to a pump, a main outlet suitable for connection to a drill pipe, and an overflow outlet suitable for connection to a fluid reservoir, the inlet being connected to the main outlet by a main flow conduit, and the overflow outlet being connected to the main flow conduit by means of an overflow conduit, wherein the overflow conduit is provided with a pressure regulator by means of which the pressure of fluid in the main conduit may be maintained at or around a predetermined pressure value.

By virtue of the provision of such an overflow conduit, when the control system is fitted to drilling system with the inlet connected to the main rig mud pump, the main outlet connected to the drill pipe, and the overflow outlet connected to the mud reservoir, the mud pressure in the drill pipe can be maintained at a generally constant pressure without any intervention by the driller. Any of the events described above – plugging of the drill pipe, application of excessive weight to the bit or stalling of the motor, the driller does not have to adjust the pump speed to avoid actuation of one or more pop-off valves.

A valve may be provided in the overflow conduit, the valve being movable from an open position in which flow of fluid along the overflow conduit is permitted and a closed position in which the valve acts to substantially prevent flow of fluid along the overflow conduit.

The apparatus may include an annulus outlet which is connected to the main conduit between the overflow conduit and the main outlet by an annulus conduit. In this case, preferably yet another adjustable choke is provided in the annulus conduit. Where a choke is provided in the main conduit, preferably the annulus conduit is connected to the main conduit between the overflow conduit and the choke in the main conduit.

There is disclosed~~According to a second aspect of the invention we provide~~ a drilling system including drill pipe, a pump, a fluid reservoir and a control apparatus according to the first aspect of the invention, the inlet of the control apparatus being connected to the pump, the main outlet of the control apparatus being connected to the drill pipe, and the overflow outlet of the control apparatus being connected to the fluid reservoir.

Preferably a pressure containment device is provided around the drill pipe, the pressure containment device being capable of containing fluid pressure in the annular region around the drill pipe. In this case, the pressure containment device may be a rotating control device, the rotating control device being capable of containing fluid pressure in the annular region around the drill pipe whilst allowing for rotation of the drill pipe about its longitudinal axis.

An annulus return conduit is preferably provided between the annular region around the drill pipe and the fluid reservoir. In this case, where a pressure containment device is provided, the annulus return conduit may be provided with a pressure regulator by means of which the pressure in the annular region around the drill pipe may be adjusted. The pressure regulator preferably comprises a choke which is adjustable to restrict flow of fluid along the annulus

return conduit to a greater or lesser extent, and may include a pressure sensor which provides a signal indicative of the fluid pressure in the annular region around the drill pipe. The pressure regulator may also include an electronic control unit which is connected to the pressure sensor to receive an input signal from the pressure sensor indicative of the fluid pressure in the annular region around the drill pipe, the electronic control unit being further connected to the choke and programmed to generate and transmit to the choke a control signal, receipt of which causes the choke to adjust the extent to which fluid flow along the annulus return conduit is restricted. In this case, the electronic control unit is preferably programmed to monitor the input signal from the pressure sensor and if the pressure in the annular region around the drill pipe differs to a specified extent from a predetermined value, to calculate and transmit to the choke one or more appropriate control signals to return the pressure to the predetermined value. Moreover, the electronic control unit may be provided with an input adapted to receive a signal indicating the desired pressure of fluid in the annular region around the drill pipe, and is programmed to calculate and transmit to the choke an appropriate control signal to achieve the desired pressure.

Advantageously, the drilling system further includes an annulus conduit which extends from the main conduit to the annular region around the drill pipe. The annulus conduit is preferably provided with a choke which is adjustable to restrict flow of fluid along the annulus conduit to a greater or lesser extent. Further preferably the annulus conduit is provided with a valve which is operable to substantially prevent flow of fluid along the annulus conduit.

There is disclosed~~According to a third aspect of the invention we provide~~ a method of operating a drilling system including a control apparatus, the control apparatus having an inlet, a main outlet and an overflow outlet, the inlet being connected to the main outlet by a main flow conduit and the overflow outlet being connected to the main conduit by an overflow conduit, the overflow conduit being provided with a pressure regulator, the drilling system further including a drill pipe

connected to the main outlet of the control apparatus, a pump connected the inlet of the control apparatus, and a fluid reservoir connected to the overflow outlet, wherein the method includes the steps of operating the pump to pump fluid into the drill pipe via the main flow conduit of the control apparatus, and operating the pressure regulator to maintain the pressure of fluid in the overflow conduit at or around a predetermined level.

Preferably the pressure regulator comprises an adjustable choke, and the method includes the steps of adjusting the choke to increase restriction of fluid flow along the overflow conduit if the pressure of fluid in the overflow conduit is below the predetermined level or adjusting the choke to decrease restriction of fluid flow along the overflow conduit if the pressure of fluid in the overflow conduit is above the predetermined level.

The control apparatus may also include a further choke which is located in the main conduit between the overflow conduit and the main outlet, in which case the method may also include the step of operating the main choke to alter the extent to which flow of fluid along the main conduit is restricted. The provision of such a choke is advantageous as it means that one control needs to be manipulated in order to alter the flow of mud along the drill pipe, even if two mud pumps are being used.

Preferably the pump is connected to the mud reservoir such that operation of the pump causes fluid in the reservoir to be pumped into the control apparatus.

The drilling system may include an annulus return conduit which extends between the annular region around the drill pipe and the fluid reservoir, the annulus return conduit being provided with a choke which is adjustable to restrict flow of fluid along the annulus return conduit to a greater or lesser extent, in which case the method may further include the steps of operating