CLAIMS

1. A combined balancing and control valve suitable for use in a hydronic system, the valve comprising a chamber enclosing a plug ~~(6, 10, 16, 15)~~, a seat ~~(13)~~ and an adjustment means ~~(20-28)~~ for adjusting the separation of the plug ~~(6, 10, 16, 15)~~ and the seat ~~(13)~~, monitoring means for monitoring the rate of fluid flow across the separation and wherein ~~characterized in that~~ the adjustment means comprises a motion transformation means ~~(20-27)~~ operable by an actuator ~~(28)~~ to control the motion of the valve plug ~~(6, 10, 16, 15)~~ whereby to provide a favourable change in conductance of the valve for a given change in the actuator position and ~~in that~~wherein the actuator ~~(28)~~ is calibrated in increments which correspond to incremental changes in the conductance.

2. A valve as claimed in claim 1 wherein ~~characterized in that~~ the actuator comprises a rod ~~(28)~~ operable on linear motion to actuate the motion transformation means ~~(20-27)~~ to adjust separation of the plug ~~(6,10, 16, 15)~~ and seat ~~(13)~~ and an associated calibration means ~~(1, 2, 29, 30, 31)~~ emerging from the chamber having a scale visible outside of the chamber and is operable to limit the maximum separation between the plug and seat which can be created by the actuator.

3. A valve as claimed in claim 1 or 2 wherein ~~characterized in that~~ calibration means ~~(1, 2, 29, 30, 31)~~ consists of one or more threaded members ~~(1, 31)~~ arranged to block the linear travel of the actuator ~~(28)~~ by a predetermined increment based on the rotation of the one or more threaded members ~~(1, 31)~~.

4. A valve as claimed in any of claims 3 wherein ~~characterized in that~~ a scale is provided about the circumference of the rotating threaded member ~~(1, 31)~~ whether in addition to the aforementioned linear scale or as the only scale.

5. A valve as claimed in any preceding claim wherein ~~characterized in that~~ the valve plug ~~(6, 10, 16, 15)~~ and seat ~~(13)~~ are arranged in axial alignment with the intended direction of flow of fluid in the system.

6. A valve as claimed in any of claims 2 to 5 wherein ~~characterized in that~~ the motion transformation means ~~(20-27)~~ engages with a toothed rack portion of the rod ~~(28)~~, which engages with a pinion ~~(21)~~ which in turn is fixed to a cam plate defining a cam guide ~~(20)~~ of a cam mechanism which cam plate rotates with the pinion ~~(21)~~ to effect movement of a cam follower ~~(23)~~, the cam mechanism being operable to adjust the separation of the plug and seat.

7. A valve as claimed in claim 6 wherein ~~characterized in that~~ the cam follower ~~(23)~~ is fixed to a shaft ~~(24)~~ to which in turn is fixedly mounted the seat ~~(13)~~ or plug ~~(6, 10, 16, 15)~~ configured such that, as the cam follower ~~(23)~~ follows the guide ~~(20)~~ provided in the cam plate axial movement of the shaft ~~(24)~~ occurs thereby adjusting the separation of the plug and seat.

8. A valve as claimed in claim 6 or claim 7 including a biasing mechanism ~~(32, 39)~~ urging the rod ~~(28)~~ to emerge from the housing ~~(14, 17)~~.

9. A valve as claimed in claim 7 or 8 wherein ~~characterized in that~~ the shaft ~~(24)~~ is received at opposing ends into front and rear bearing plates ~~(5, 22)~~ and has the same diameter where it passes through each of the two bearing plates ~~(5, 22)~~.

10. A valve as claimed in any of claims 1 to 9 wherein ~~characterized in that~~ the actuator ~~(28)~~ is driven by a drive means which is responsive to an external control signal to drive the actuator ~~(28)~~ and wherein the motion transformation means ~~(20-27)~~ is configured to translate constant motion of the drive means and actuator into a favourable motion of the plug ~~(6,10, 16, 15)~~, thereby providing a favourable change in the fluid conductance of the valve in response to the control signal.

11. A valve as claimed in any preceding claim wherein ~~characterized in that~~ the plug ~~(6,10, 16, 15)~~ and seat ~~(13)~~ are configured to provide a fluid conductance which is approximately proportional to the movement of the plug ~~(6,10, 16, 15)~~.

12. A valve as claimed in any preceding claim wherein ~~characterised in that~~ the plug ~~(6, 10, 16, 15)~~ is provided with a partial differential pressure compensation.

13. A valve as claimed in any preceding claim wherein ~~characterised in that~~ axial movement of the plug ~~(6, 10, 16, 15)~~ relative to the seat ~~(13)~~ is resisted by a biasing spring ~~(4)~~.

14. A valve as claimed in claim 13 wherein ~~characterised in that~~ the biasing spring ~~(4)~~ is arranged to urge the valve to open.

15. A valve as claimed in any preceding claim wherein ~~characterised in that~~ fluid pressure is transferred through internal chambers to minimise the force required from the driven actuator ~~(28)~~ to overcome a given pressure difference between the inlet and outlet.

16. A valve as claimed in any preceding claim wherein ~~characterised in that~~ the adjustment means ~~(20 28)~~ is operable in response to constant actuation to cause the valve to provide a change in the separation that approximately follows the equation:

$$K_v = \frac{K_{vs} \cdot \phi}{\frac{1}{h} - 1 + \phi}$$

where KV is the conductance of the valve at a given position of the actuator, K_{VS} is a maximum conductance of the valve, h is the position of the actuator ranging from 0 for a fully closed valve to 1 for fully open valve separation, and φ is an "EQM coefficient".

17. A valve as claimed in any preceding claim 1 configured to adjust the separation between the plug ~~(6, 10, 16, 15)~~ and seat ~~(13)~~ in a smooth and continuous fashion from a fully open position to the fully closed position.

18. A valve as claimed in claim 17 wherein the plug ~~(6, 10, 16, 15)~~ includes a resilient sealing means ~~(15)~~, said sealing means ~~(15)~~ being configured to cooperate with the seat ~~(13)~~ through most of the travel of the plug.

19. A valve according to any preceding claim wherein the motion transformation means ~~(20-27)~~ is located within the path of the fluid flow.

20. A valve of any preceding claim wherein ~~characterised in that~~ it is configured such that the plug ~~(6, 10, 16, 15)~~ can be adjusted to reach its fully closed position at a predefined travel of the actuator ~~(28)~~.

21. A valve of any preceding claim further wherein ~~characterised in that~~ monitoring means and calibration means are together configured to enable a user to calculate the flow rate of fluid through the valve from a reading on the scale of the calibration means ~~(1, 2, 29, 30, 31)~~ and a determination of the differential pressure across the valve.

22. A valve of any preceding claim further wherein ~~characterised in that~~ monitoring means incorporates a processor configured to calculate the flow rate of fluid through the valve from a reading on the scale of the calibration means ~~(1, 2, 29, 30, 31)~~ and a determination of the differential pressure across the valve.

23. A valve as claimed in claim 22 wherein the processor comprises a reference chart from which the flow rate for a given differential pressure and scale increment on the calibration means ~~(1, 2, 29, 30, 31)~~ can be identified.

24. A valve of claim 21 or 22 wherein the processing means is automated.