adjustable restriction and a means of measuring the flow rate. A balancing contractor is then employed to adjust these balancing valves throughout the system so that at maximum flow conditions all terminals receive the correct flow of fluid without excess.

A limitation of current techniques is that the restriction created by the balancing valve is not taken into account by the control valve, so that a portion of the control valve's stroke is wasted.

Some prior devices combine the function of a control valve and a balancing valve in a single unit, providing improved performance of the combined unit. With the control function and balancing accomplished by a single device, it is possible to provide improved control performance tailored to the exact conditions experienced at a given terminal.

Embodiments of t~~T~~he present invention seek~~s~~ to provide a control valve with an integrated balancing component which may overcome~~s~~ the problems presented by prior art arrangements.

In accordance with the present invention, there is provided a combined balancing and control valve suitable for use in a hydronic system, the valve comprising a chamber enclosing a plug, a seat and an adjustment means for adjusting the separation of the plug and the seat, 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 operable by an actuator to control~~restrict~~ the motion of the valve plug whereby to provide a favourable change in conductance of the valve for a given change in the actuator position and wherein~~in that~~ the actuator is calibrated in increments which correspond to incremental changes in the conductance.

The adjustment needed for the balancing of circuits is accomplished by limiting the maximum opening of the control valve by use of a calibrated scale which provided a known restriction at any particular setting. The flow rate reading needed for the

balancing of circuits is accomplished by reading the differential pressure across the valve restriction. In one practical embodiment of the invention, the adjustment means includes a calibration means having a scale visible outside of the chamber and is operable to adjust a maximum possible separation of the plug and seat in increments corresponding to units provided on the scale. After the balancing procedure, the actuator can change the conductance of the valve to any appropriate value between closed and the set maximum value in response to an external control signal.

In preferred embodiments, the calibration means conveniently emerges from the chamber in the form of a rod having a linear scale presented along its length and linear movement of the rod is translated to one or both of the valve seat and plug whereby to adjust the separation of the seat and plug by an amount which corresponds to the distance travelled by the rod according to the linear scale.

In an option, the rod is surrounded by a threaded sleeve operable to limit its travel, which engages with a complementary thread fixed relative to the chamber and linear movement is effected by rotating the sleeve. Optionally, the sleeve could be prevented from rotating, and it could engage against a nut which is translationally fixed with respect to the housing. In either option, a scale may be provided about the circumference of the rotating element whether in addition to the aforementioned linear scale (for example to allow fine adjustment) or as the only scale.

Desirably the valve and seat are arranged in axial alignment with the intended direction of flow of fluid in the system. In an axial geometry, fluid flows into and out of the valve along a single axis, and the valve has a plug which moves along that same axis. This geometry may provides reduced turbulence and consequently less noise than geometries which require the fluid to change direction excessively. This geometry may also allows the valve to be more compact than other geometries.

In one preferred embodiment, the calibrated rod extends into the chamber to include a toothed rack portion, this engages with a pinion which in turn is fixed to a cam

embodimentsinvention, this problem may beis addressed by providing two shafts of equal diameters arranged for simultaneous axial movement in opposing directions between the two areas of different pressure.

As already stated, in some embodiments, one or more springs may be provided to create a biasing force, such that the valve is either always urged toward an open position or always urged towards a closed position. In such cases the balancing of the differential pressure may additionally be configured to provide a "biasing force" in the same direction.

By way of example an embodiment of the invention will now be further described with reference to the accompanying drawings in which:

Figure 1 shows a side view of a valve in accordance with the invention in partial cut away view;
Figure 2 shows a top view of the valve of Figure 1 in partial cut away view;
Figure 3 shows the valve in cross section partially through its travel;
Figure 4 shows an external side view of the valve with an electromechanical actuator attached.

The valve of Figure 1 generally comprises a housing (14, 17) which defines a chamber in which is provided a plug assembly (6, 10, 15, 16) and a seat (13) in axial alignment along the direction of flow of fluid in hydronic system. The plug (6, 10, 15, 16) is carried on a shaft (24) whose axis passes through the centre of the plug (6, 10, 15, 16). The shaft (24) also carries a cam follower assembly (23, 25). A calibration means is provided in the form of assembly (1, 2, 29, 30 and 31) which interacts with a rod (28) which passes through a sealed inlet chamber which is free to slide axially by means of a bearing mounted in the inlet. The rod is adapted to connect to an electromechanical or other controlled drive means. The calibrated stroke limiting mechanism (1, 2, 28, 29, 30, 31) is provided to adjust the maximum opening of the valve during a balancing procedure.