

K S B Aktiengesellschaft

Description

5 Section control valve

The invention relates to a section control valve for setting and measuring volume flows in pipes, in particular in pipes of supply systems, it being possible for an actual state of a volume flow to be recorded with the aid of measuring instruments with evaluation and display devices and for a desired state to be set by means of a control member of the valve.

15 Piping systems distribute a conveying medium to individual usage points within a building or in a plant. Such piping systems usually have a large number of branches, and there is the problem of guaranteeing a supply which meets the respective demand under full
20 load at the individual usage points. Such an adjustment takes place for the most unfavourable operating state of a piping system, in which all the users demand the maximum supply at the same time. In this case, the supply to the users, for example heat exchangers,
25 should neither be insufficient nor excessive. For this purpose, it is known to adjust the individual pipe sections accordingly.

Section control valves which are fitted with connections for pressure-measuring lines form an aid used for this purpose. A separate pressure-measuring device which can be connected thereto measures the differential pressure inside the valve between two measuring points which are spaced apart from one another. There is usually also a shut-off member of the section control valve located between the two measuring points. After the differential pressure has been measured, the current volume flow is determined with the aid of existing specific characteristic values of

the valve and knowledge of the position of the shut-off member relative to the associated seat. By changing the position of the shut-off member, the volume flow is changed in order to set a desired volume flow by means
5 of further measuring and control operations. Such valves for section control are known by the publications DE-C 40 30 104, EP-A 0 671 578 and WO 92/03677.

10 This kind of section control is very time-consuming and cumbersome, and it is even more awkward to carry out in the case of large and branched pipe sections. In this context, it is also known to convert the differential pressures determined in section control valves into the
15 respective throughflow volumes with the assistance of measuring computers. For this purpose, the specific data of a valve must be stored in the measuring computer. To do so, it is also absolutely essential to know the momentary position of the shut-off member in
20 relation to the associated seat. Changing the position of the shut-off member causes a change in the throughflow volume. Depending on the construction, the respective stroke or rotational position of a shut-off member of a section control valve must be recorded by
25 the operator and, in addition, entered manually on the measuring computer.

Although such section control valves permit an exact setting of the throughflow volumes in different pipe
30 sections, they also have many disadvantages. There is the risk of the measuring bores in the housing becoming soiled; considerable measuring errors may occur if the necessary pressure-measuring lines have not been vented with extreme care. Furthermore, the assembly and the
35 disassembly of the measuring lines at the pressure measuring points of a pressurized housing in which high temperatures and/or pressures can prevail constitute a great hazard potential. To avoid inaccuracies in the measurements which result due to eddying inside the

housing and in the case of which the eddies have adverse effects on the measuring parameter, sufficiently long settling routes are usually required in front of and behind the measuring points in order to
5 guarantee sufficient measuring accuracy. The handling of the overall measuring device is also very awkward.

Another type of adjustment of pipe sections is known from the product TACO-SETTER, which is published in the
10 catalogue of the company Gebrüder Tobler AG, Haustechniksysteme, CH-8902 Urdorf, 1994 edition, pages 2.59 and 2.60. This is a throughflow measuring device which can be inserted directly into a piping system and has an integrated fine control valve. The throughflow
15 volume displayed by the throughflow measuring device can be changed with the aid of the fine control valve. However, this solution has the disadvantage that its use is limited to clean liquids. Owing to the mechanical construction of this throughflow measuring
20 device, periodic servicing and additional monitoring outlay are required. In the case of soiled media, incorrect measurements are therefore to be expected. Additionally, such a throughflow measuring device which is installed directly in the flow path also changes the
25 flow resistance in the piping system. Attempts are made to avoid the latter disadvantage by means of another solution by arranging the throughflow meter in a bypass line to a shut-off valve. Although this solution improves the operability, it brings about a reduction
30 in the measuring accuracy.

A sensor in the form of a pressure monitor with integrated temperature measurement is known from
FR-A-2 713 764. This sensor which is to be installed in
35 a pipe has a diaphragm which reacts to changes in pressure. If stipulated threshold values are exceeded, a switch-on or switch-off signal is thus emitted. With the aid of the temperature recording device, the

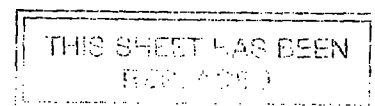
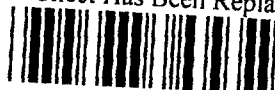
presence of a flow is also determined at the same time and is displayed with the aid of additional devices.

The so-called inductive throughflow measuring devices are, for example, very precise and contactless without causing any additional flow resistance. Since they are very expensive, they are usually only used for short times for adjustment at a measuring location. This necessitates great expenditure in the form of shutting down the plant, emptying the plant and installing and dismantling the measuring device, and subsequently starting up the plant. If the construction of a plant is changed, repeat measurements are required, entailing equally great expenditure.

The invention is based on the problem of developing a simple possibility of adjusting pipe sections, with the aid of which a volume flow can be adapted in a less complex manner to the respective conditions of the pipe.

The solution to this problem envisages that a sensor which directly or indirectly records the volume flow of the flow chamber is arranged in the region of the flow chamber, that specific characteristic values of the section control valve are stored in an electronic data store, and that an evaluation unit determines the volume flow from the values measured by the sensor and from the characteristic values of the data store. It can usually be assumed that the sensor is located at an installation site with constant or reproducible flow conditions in the inflow region of the valve housing. Existing shut-off valves, preferably lifting valves with good throttling properties, can thus be used in a simple manner as section control valves at the same time. Section control valves with special measuring bores which are of complicated design and manufacture and the risks involved with the connection of measuring lines can be dispensed with. It is sufficient for the manufacturer to integrate a sensor into a housing of a

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shut-off valve, the surface of the sensor being at least flush with the flow chamber or protruding slightly into the latter. The volume flow can thus be measured without having a disturbing effect on the flow. For this purpose, a measuring parameter is used which is provided by the sensor and is in relation to the volume flow. The dependency of this measuring parameter on the volume flow prevailing in the valve is preferably determined with the aid of a calibration operation. Other methods, for example calculatory methods, may also be used for the allocation of the measuring parameter to the volume flow. The sensor remains permanently in the housing and is arranged in a sealing manner therein. Thus, if such a section control valve is used, it is no longer necessary to intervene in the pressure-conducting piping system when there is a demand. Depending on the construction, the volume flow could be read from the evaluation unit directly or after setting up a data connection. This can be done without difficulty and poses no risk to the operator or the environment.

According to a further solution to the problem, the flow chamber of the section control valve is operatively connected to the flow chamber of a separate flow housing, a sensor which directly or indirectly records the volume flow of the flow chamber is arranged in the region of the flow chamber of the separate flow housing, and specific characteristic values of the section control valve configured as a constructional unit are stored in an electronic data store, and an evaluation unit determines the volume flow from the values measured by the sensor 6 and from the characteristic values of the data store.

This enables a standard shut-off valve to be converted to a section control valve in a simple manner. The arrangement of the flow housing containing the sensor in the immediate vicinity of the shut-off valve makes

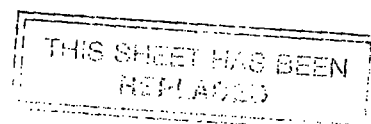


it possible to manufacture a section control valve as a constructional unit which is easy to assemble. A section control valve which is manufactured as a constructional unit in this way merely requires a single calibration in order to be able to cover the flow-related operative connection. The flow-related operative connection is influenced by a change in the position of the control and/or shut-off member. The calibration of the constructional unit provides the precondition in order to be able to carry out expedient measurements with the aid of the sensor. Compared to volume-flow measuring instruments which have to be installed in a pipe separately, the section control valve configured and calibrated as a constructional unit results in a considerable shortening of the construction length. This is because this overall arrangement can dispense with a settling route between the separate flow housing and the section control valve, which settling routes are absolutely essential for settling the flow to be measured between commercially available volume-flow measuring instruments and section control valves.

For example in existing piping systems, so-called old plants, this permits shut-off valves with a long valve construction length to be replaced by a section control valve which, as a constructional unit, consists of a compact valve of short length and a separate flow housing with an integrated sensor. Using adapters which may be necessary to compensate the difference in the construction lengths, installation is possible without changing the existing pipe.

The sensor employed converts the physical parameter to be measured and its change into an electrical parameter and its change, which can be further processed or transmitted electronically. Depending on the construction of the sensor and the degree of integration and/or miniaturization employed, both

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signal preparation and signal processing can be incorporated in the sensor.

5 A refinement of the invention envisages a sensor which operates according to the calorimetric measuring principle. Depending on the valve housing employed, an installation site is selected for the sensor, at which reproducible flow conditions prevail within the relevant throttling range, which flow conditions, 10 irrespective of the position of the shut-off body, are in relation to its seat. This is the case in a simple manner on the inflow side of a flow-conducting housing, in particular in the region of the entry flange, specifically offset by 90° relative to the spindle 15 axis. It is thus no longer necessary for the determination of the volume flow to record the position of the shut-off body in relation to its seat. The relation between the measuring signal and the volume flow is determined, for example, experimentally in the 20 form of a calibration operation.

If valves are employed, in which there are difficult flow conditions owing to the shape, a plurality of sensors can be used. These are then arranged 25 distributed over the circumference in the region of the flow cross-section to be measured. For such applications, the volume flow is determined by forming a mean value from the values measured by the individual sensors.

30 A further refinement of the invention envisages that the sensor in the wall of the flow chamber is at least flush with the surface or protrudes with a slight projection into the flow chamber. This measure 35 guarantees, on the one hand, reliable recording of the volume flow which is in a reproducible relation to the measuring signal. On the other hand, any increase in the resistance coefficient of the valve thus caused is negligible.

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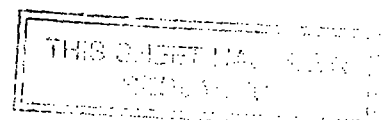


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According to a further refinement of the invention, the evaluation unit may be connected to the sensor directly or by connecting means. The evaluation unit can thus be mounted as a compact, highly integrated unit directly
5 on the sensor or with the interposition of connecting means on the valve. The volume flows prevailing momentarily in the valve can be read off directly with the aid of display devices. Depending on the construction of the evaluation unit, this could take
10 place continuously or only when there is a demand.

According to a further refinement, the housing-specific characteristic values are contained in the electronic data store in the form of a table, in the form of a
15 characteristic curve or as an algorithm. If the sensor is, for example, integrated into a flange of a valve housing and is fitted with its own electronic data store, section control can take place in a very simple manner. The characteristic values typical of a specific
20 housing are stored permanently in the installed sensor. Every sensor can be calibrated by the manufacturer in accordance with its specific installation site. In order to adjust a plant precisely, an evaluation unit must be connected to the sensor. Based on the measuring
25 parameters provided by the sensor and in conjunction with the associated characteristic values, the desired volume flow can be adjusted quickly and without difficulty in a very simple manner with the aid of the evaluation unit. For this purpose, the position of the
30 shut-off member merely has to be changed manually or automatically depending on the design. It is not necessary to input an additional calculation variable, e.g. the position of the shut-off body. When setting up a calibration curve, the associated measurements for
35 several and different preset volume flows within the relevant volume flow range of the respective housing are recorded and allocated. Inaccuracies are thus compensated; the result is more precise and savings can be made compared to the previous partially manual and

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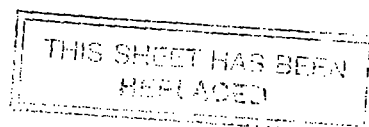


calculatory outlay. The data can be stored in the electronic data store as a characteristic curve, table, algorithm or in another known form. It is also possible to determine and display the mass flow from the volume
5 flow with the aid of known means.

Further refinements of the invention are described in Claims 6 to 9. Accordingly, the electronic data store can contain the housing-specific characteristic values
10 in the form of a table, in the form of a characteristic curve or as an algorithm. Depending on the type and construction of the electronic data store used, the characteristic values typical of the specific valve can be stored in a form which permits unproblematic read-
15 out by means of an evaluation unit and the computing elements located therein. The data store may also be integrated into the sensor or into the evaluation unit. The data store may likewise be arranged partially in the sensor and partially in the evaluation unit, the
20 data store integrated into the sensor containing at least one valve code. Furthermore, in addition to a microcontroller, the evaluation unit contains a voltage supply which can be configured as a connection to an external apparatus or is present as an internal
25 apparatus in the form of batteries, accumulators or the like. Additionally display devices, operating elements and the necessary connection elements.

The adjustment of a section takes place by means of
30 simply adjusting the shut-off member of the section control valve to the desired volume flow displayed in the evaluation unit. Depending on the requirement, the evaluation unit may be configured as a permanently installed component or as a mobile device. The
35 connection between the evaluation unit and the respective sensor can be made with the aid of customary connection means. These may be permanent or releasable connections or wireless communication means, such as infrared transmission, radio waves and the like.

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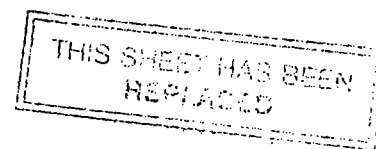
Other refinements of the invention envisage that a data store with a small storage capacity integrated into the sensor contains a valve code, and that an electronic data store located in the evaluation unit contains characteristic values of the valve in characteristic curves or in the form of a table.

In this case, the evaluation unit has a considerably larger electronic data store with all the characteristic values of the valves which can be adjusted therewith. The small data store of a sensor then contains only a code on that section control valve in which it is installed. In the case of communication between the sensor and the evaluation unit, the corresponding valve data is read out from the larger store of the evaluation unit based on the respective code and is made available for processing. Customary storage media may be used as electronic data stores.

With the aid of one or more interfaces which can be connected to a bus system, the values measured by the sensor and the respective characteristic curves of the assigned housing can also be transmitted to a central control or switching point. By means of the data exchange via the interfaces, the data or the values measured can be exchanged with a central control or switching point or with other elements of the piping system.

It is also possible to integrate a display into the evaluation electronics which directly displays the current volume flow based on the measuring variables recorded by the sensor. In order to minimize the constructional outlay, the sensor is configured as a passive element whose voltage supply is ensured with the aid of the evaluation unit. In this case, the known energy sources can be employed.

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Furthermore, an element may be integrated into the sensor, with the aid of which element the temperature of the medium located inside the housing can be recorded. This value can also be illustrated directly
5 on the display of the evaluation unit.

A further advantage can thus be achieved in a very simple manner by the fact that the heat output transported inside the pipes and/or the heat
10 consumption are calculated and displayed. The heat output present in piping systems can be calculated from the measurement or calculation of the temperature difference, for example between the forward flow and return flow, and the volume flow. Only one additional
15 time record is required to calculate the heat consumption. The measuring and calculation values required and additional construction and operating elements can be integrated into the evaluation unit or into a central control point. The sensors can also be
20 connected to such a control point with the aid of appropriate connection lines.

A major advantage of this invention also consists in the fact that the respective volume flow and the
25 momentary medium temperature can be read off directly at the section control valve without any further manual effort. The additional throughflow measuring instruments for the pipe previously required for this purpose are dispensed with as is the awkward pressure-
30 loss measurement, which required additional hose connections to a section control valve. The expenditure for the respective adjustment is thus reduced considerably and a saving in space is also possible at the same time. Integrating the sensor into an ordinary
35 shut-off valve or into a separate flow housing which interacts therewith does not change its shut-off function, and the use of a special section control valve with the problematic connection lines for the recording of measurement data can be dispensed with.

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The evaluation unit also permits a desired value of the required volume flow to be input directly into the evaluation unit during an adjustment operation. With the aid of the transmission means between the evaluation unit and the sensor, this desired value can be stored in the data store of the sensor. Depending on the construction of the plant, it is possible to establish in a very simple manner, with temporary or permanent monitoring by means of a target/status comparison, whether there is any discrepancy. If this were to be the case, a readjustment can be carried out by actuating the valve. The control mechanism may be a customary handwheel, a hand lever or an adjusting motor. Owing to the possibility of direct visual recording of the momentary volume flow on a display and without the additional outlay in terms of measuring equipment to record the location or position of the shut-off members, readjustment is possible in a very simple manner. If the evaluation unit, which can be used in a stationary or mobile manner, were to be arranged permanently on a housing to be monitored, the possibilities of fastening it are selected so as to allow a display irrespective of the installation position of the housing to be monitored.

Exemplary embodiments of the invention are illustrated in the drawings, and are described in greater detail below.

Figure 1 shows a plan view of a shut-off valve configured as a section control valve, with a partial section;

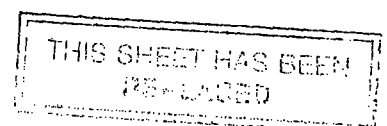
Figure 2 shows another view of a display unit;

Figure 3 shows a section control valve as a multi-part constructional unit; and

Figure 4 shows a technical modification of Figure 3.

Figure 1 shows a plan view of a section control valve 1 which is fitted with flanges 2, 3 and a hand wheel 4.

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In this exemplary embodiment, a sensor 6 is integrated into the flange 2 on the inflow side 5. Owing to the size of the sensor shown here, the flange 2 has a recess 7 with a bore 8. This bore 8 receives the sensor 6 which, with its end 10, protrudes slightly into the flow chamber 11. A certain projection over the wall surface 12 of the housing of the flow chamber 11 has proved to be expedient in order also to cover the actual flow conditions outside the boundary layer flow located in the edge zone. Escape of the flow medium from the bore 8 is prevented with the aid of seals 13. The mechanical securement in the axial direction is effected by a securing ring 9. Depending on the construction of the housing, the sensor may also be arranged at a different location at which the integration can be carried out with little outlay.

Here a connecting means 14, which is connected to a display unit 15, is connected to an output of the sensor. In this case, the connecting means may be configured as a plug-in, screw-in or other customary connecting means to produce electrical connections.

The display unit 15 may be supplied from an external voltage source 16 and/or have an integrated voltage source. In this case, this may be accumulators, batteries, mains devices and the like. With the aid of appropriate switching or display elements, the respective volume flow and possibly also the respectively prevailing temperature can be displayed permanently or when required.

The specific characteristic values for the housing of this section control valve are stored in a data store of the sensor 6. A corresponding calibration and programming operation can be carried out by the manufacturer or, if required, input at the installation site. For the adjustment, the sensor 6 is connected to an evaluation unit which reads out the respective



characteristic values from the integrated data store and calculates and displays the throughflow volume with the aid of the measuring signal without further parameters such as, for example, the stroke position to
5 be entered manually with the Δp method. The storage of the respective characteristic values of the housing directly in the sensor serves in a very simple manner to avoid errors. In the case of those apparatuses in which the corresponding characteristic values are
10 stored in an external unit, it must be ensured that, for an adjustment, a precise allocation between the housing to be adjusted and the associated characteristic values also takes place.

15 The view of the display unit illustrated in Figure 2 shows a possible design of a target/status comparison. To adjust the volume flow, it has control lamps of different coding or colour. When using light-emitting diodes 17, 18, 19 of different colours, red light-emitting diodes 17, 19 may display inadmissible volume
20 flows, while a green light-emitting diode 18 is used for the admissible volume flow. A simple setting as well as later checking by comparing the colours would thus be possible. The voltage supply for the display
25 unit can be branched off from a mains. Here too, the possibility of storing the characteristic values inside the sensor advantageously provides a simple calibration possibility and an easier possibility of later adjustment. Another possibility of the target/status
30 comparison consists in illustrating in the display the indication LOW if the value drops below the desired value or the indication HIGH if the desired value is exceeded.

35 A display 20, which is illustrated here as a digital display, illustrates the volume flow measured. The technical measuring unit employed for this purpose can easily be adapted to different systems of units and is



not limited to the unit m^3/h shown. An analogue display can likewise be used.

Figure 3 shows a section control valve which is
5 configured as a multi-part constructional unit. For
this purpose, a customary shut-off valve (in the
illustration a compact valve with a short construction
length was used) can be connected to a separate flow
housing 22, a sensor 6 being integrated into the
10 separate flow housing 22. By way of example, a sensor
arrangement was shown here which uses a plurality of
sensors 6. These are arranged distributed over the
circumference. The angular distance of the sensors must
be adapted to the flow conditions prevailing in the
15 valve. In this case, the flow housing 22 can be of
single-part or multi-part configuration. Such a sensor
arrangement is also possible in an in an [sic]
embodiment as is shown in Figures 1 and 4. The
arrangement, fastening and sealing of the sensors 6
20 corresponds to the illustration of the sensor in Figure
1. The sensor 6 can be flush with the surface with its
end 10 or can protrude with a slight projection into
the flow chamber 23 of the flow housing 22. In this
exemplary embodiment, the flow housing 22 is configured
25 as a flange disc in order to enable a simple connection
to be made, with the interposition of seals 24 or
adapters, with the shut-off valve 21 shown as a flange
valve and pipes (not illustrated here). The calibration
of this section control valve configured as a
30 constructional unit takes place in the assembled form
in order to be able to include all the influences. Such
a section control valve configured as a constructional
unit is suitable for reconstruction work on already
existing piping systems. Thus, a section control valve
35 configured as a section control valve unit can be used
instead of a shut-off valve with the customary long
valve construction length. Owing to the fact that the
section control valve unit has been calibrated once, in
terms of measuring technology reproducible measuring

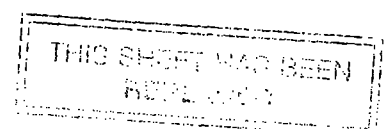


results can be achieved without difficulty, with which it is possible to carry out a precise adjustment of pipe sections of a wide variety of types. The major advantage of such a section control valve consists in
5 the short construction length compared to the previously customary volume flow measuring instruments with their long settling routes which were necessary for operational reasons.

10 Figure 4 shows a section control valve configured as a constructional unit with a different type of connection. The shut-off valve 25 has a housing of a sleeve construction into which pipes to be connected can be plugged or screwed. In accordance with the
15 internal construction of the valve, a separate flow housing 26 with a sensor 6 arranged therein in a similar way to Figures 1 and 3 is fastened on that side of the housing which, during the calibration, yields the most favourable reproducible values. As shown in
20 the tests, this is usually the inflow side. The installation of the sensor 6 is not limited to the form illustrated. Depending on the shape and construction of the sensor, a different type of installation, sealing, fastening and connection can also be selected than that
25 shown. The size of the sensor 6 used and the shape of its housing permit screw, clamping, rivet, bonded and other known types of sensor fastening.

A section control valve can thus be manufactured which
30 can be produced as a functional unit in a very simple manner from a modification of a serial product. By simple direct or indirect adaptation of a sensor in or on a housing of a shut-off valve, in which case designs with good throttling properties are advantageous but
35 are not a precondition, and with measuring calibration of a section control valve formed in this way, a section control valve is produced for the convenient adjustment of pipe sections.

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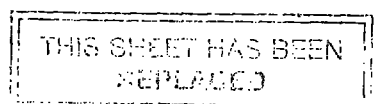


Patent Claims



1. Section control valve for setting volume flows in pipes, in particular in pipes of supply systems, it being possible for an actual state to be recorded with the aid of measuring instruments, evaluation and display devices and for a desired state to be set by means of a control and/or shut-off member arranged in a flow chamber of the section control valve, characterized in that at least one sensor (6), which directly or indirectly records the volume flow of the flow chamber (11), is arranged in the region of the flow chamber (11), in that specific characteristic values of the section control valve are stored in an electronic data store, and in that an evaluation unit determines the volume flow from the values measured by the sensor (6) and from the characteristic values of the data store.
2. Section control valve for setting volume flows in pipes, in particular in pipes of supply systems, it being possible for an actual state to be recorded with the aid of measuring instruments, evaluation and display devices and for a desired state to be set by means of a control and/or shut-off member arranged in a flow chamber of the section control valve, characterized in that the flow chamber of the section control valve is operatively connected to a flow chamber (23) of a separate flow housing (22), in that at least one sensor (6), which directly or indirectly records the volume flow, is arranged in the region of the flow chamber (23) of the separate flow housing (22), in that specific characteristic values of the section control valve are stored in an electronic data store, and in that an evaluation unit determines the volume flow from the values

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measured by the sensor (6) and from the characteristic values of the data store.

3. Section control valve according to Claim 1 or 2,
5 characterized in that the sensor (6) operates according to a calorimetric measuring principle.
4. Section control valve according to Claim 1, 2 or
10 3, characterized in that the sensor (6) in the wall (12) of the flow chamber (11, 23) is at least flush with the surface or protrudes with a slight projection into the flow chamber (11, 23).
5. Section control valve according to one of Claims 1
15 to 4, characterized in that the evaluation unit is connected to the sensor (6) directly or by connecting means (14).
6. Section control valve according to one of Claims 1
20 to 5, characterized in that the electronic data store contains the housing-specific characteristic values in the form of a table, in the form of a characteristic curve or as an algorithm.
- 25 7. Section control valve according to Claim 6, characterized in that the data store is integrated into the sensor (6).
8. Section control valve according to one of Claims 1
30 to 7, characterized in that a data store integrated into the sensor (6) is designed to have a small storage capacity and to contain a valve code.
- 35 9. Section control valve according to one of Claims 1 to 8, characterized in that the data store is integrated into the evaluation unit.

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10. Section control valve according to one of Claims 1 to 9, characterized in that the evaluation unit and/or the sensor (6) has one or more interfaces for data exchange.
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11. Section control valve according to one of Claims 1 to 10, characterized in that the evaluation unit is arranged on the section control valve or on the flow-conducting housing.
- 10
12. Section control valve according to one of Claims 1 to 10, characterized in that the evaluation unit is configured as a mobile device.
- 15
13. Section control valve according to one of Claims 1 to 16, characterized in that the evaluation unit is integrated into one or more sensors (6).
- 20
14. Section control valve according to one of Claims 1 to 13, characterized in that the evaluation unit is provided with a display (15).
- 25
15. Section control valve according to Claim 14, characterized in that the evaluation unit is provided with and/or connected to a voltage supply (16).
- 30
16. Section control valve according to one of Claims 1 to 15, characterized in that the sensor (6) is arranged on the inflow side of the flow-conducting housing.
- 35
17. Section control valve according to one of Claims 1 to 16, characterized in that the sensor (6) is fitted additionally with a temperature recording device to determine the heat output and/or heat quantity.

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