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Description

Device for transmitting measured values

- 5 The invention relates to a device for transmitting measured values, having a sensor module, which comprises miniaturized components and is arranged on a centrifugal pump arrangement with a pump and a drive motor, and an evaluation unit, the sensor module having connections for different sensors, the sensor module being connectable to one or more sensors which detect operating states of the centrifugal pump arrangement with a pump and a drive motor as measured values, and the sensor module having a connection for the power supply and processing the measured values.

- In the case of a centrifugal pump arrangement with a pump and a drive motor, monitoring is known to be very complicated and cost-intensive. By way of preventive maintenance, such machines are provided with sensors for monitoring the operating states in the form of temperatures, pressures, flow rates, vibrations and the like. This signifies a considerable amount of complexity when detecting measured values. The different sensors required for this purpose must be respectively installed at the corresponding locations of a machine, individually wired and connected to different evaluation devices.

- US 5 839 094 A discloses a portable data acquisition device which is used for training purposes, in particular in the laboratory environment of schools. The device has various inputs for connecting various sensors. The sensors are connected to the device via a special coupling means. This coupling means contains an identification means which provides the device with information relating to the type of sensor. A sensor memory means in the coupling means is used to store sensor-related data such as calibration information, information relating to the unit of a measurement variable or format information. Special sensors can be connected to the device via a special coupling means. The use of cost-effective standard sensors which are used in a centrifugal pump arrangement is not provided. Moreover, the portable laboratory device is not suitable for permanent use on a centrifugal pump arrangement.

EP 0 330 347 A1 discloses a monitoring module for monitoring a multiplicity of functions and conditions of an agricultural machine such as a tractor. A programming means which supplies a memory with data and instructions is used to input data. In the case of this monitoring module, a multiplicity of data items need to be input upon activation, which entails the risk of incorrect operation. In addition, it is used only to display measured values on a machine and not to transmit measured values.

EP 0 905 596 A2 relates to a pump arrangement for pressure regulation, having at least two centrifugal pumps which are connected in parallel and are intended to convey variable quantities of liquids in pipeline systems, a sensor for capturing the conveying pressure of the pump arrangement being arranged on its pressure side and a microprocessor system regulating the conveying pressure on the basis of the signal from the pressure-side sensor by influencing the speed of at least one centrifugal pump. The microprocessor system automatically adapts a lower adjustment range limit in the form of the minimum speed of the regulating pump at discrete times during activation or deactivation of one or more centrifugal pumps on the basis of a predefined desired value and/or a determined actual value of the conveying pressure according to a predefined formula.

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EP 0 733 883 B1 discloses a device for transmitting measured values, having a sensor module and an evaluation device, for use in submerged motor-driven pumps and submersible motor-driven pumps. A plurality of different sensors can be connected to a sensor module which is integrated in a machine and the measured values from said sensors can be processed. However, integrating the sensor module in an electrical drive motor in the region of the winding head necessitates a special shielding and pressure-resistant and liquid-tight housing. There is a need for a separate evaluation device in order to evaluate the measured values which have been pre-processed in the sensor module. For this purpose, each connected sensor needs to be assigned according to the type and measurement range. However, this requires complicated manual parameterization of the evaluation device with the risk of the properties of the special pump and its use being mixed up. In addition to the risk of faults, this results in a

30

complicated marketing and settlement process, in particular if the device is intended to be retrofitted to an existing pump belonging to the customer.

Therefore, the invention is based on the problem of developing a simple device for
5 detecting, processing and transmitting measured values for centrifugal pump arrangements, in which the risk of incorrect manual operation is precluded.

The solution to this problem provides for the sensor module to determine the sensors by identification means, for the sensor module to be in the form of a signal transmitter
10 with a standardized output signal, for the evaluation unit to have a microcomputer, to be integrated into the sensor module and to be designed with a display, and for the evaluation unit to process the measured values and to display measured values and/or calculated variables on the display and for the signal transmitter to have a memory apparatus containing technological data for the pump and/or the drive motor, the
15 microcomputer calculating and evaluating operating data and operating states of the centrifugal pump arrangement with the aid of the measured values and the stored data.

This provides a compact device for transmitting measured values, which device completely dispenses with operator inputs. The identification means provides the
20 signal transmitter with the type and measurement ranges of the sensors. Start-up solely involves connecting the sensors, as a result of which it is no longer necessary to parameterize the signal transmitter.

According to the invention, identification means which are arranged in the signal
25 transmitter and/or in the evaluation unit of the latter are also provided. For this purpose, suitable data, for example sensor data or the like, may be stored in a memory apparatus in the signal transmitter.

As a result of the integrated evaluation unit with a microcomputer and a display,
30 signals are processed in an error-free manner and measured values and calculated variables are displayed. Measured values and/or calculated variables may be displayed in a cyclically alternating manner. Alternatively, measured values and/or calculated

variables are permanently displayed. In addition, the display may have means for displaying alarms and warnings. There is no longer any need for any means for executing manual operating functions on the signal transmitter.

- 5 The fact that the sensor module has a memory apparatus containing technological data for the pump and/or the drive motor, the microcomputer calculating and evaluating operating data and operating states of the centrifugal pump arrangement with the aid of the measured values and the stored data, results in the further advantage that the number of sensors required is reduced to a minimum since technological data for the
- 10 pump and/or the drive motor are stored in the memory apparatus. As a result, further characteristic variables of the centrifugal pump arrangement can be calculated in combination with the measured values.

- Provision is likewise made for the sensors which are connected to the sensor module to
- 15 be able to be identified according to sensor type and measurement range by data stored in the memory apparatus. A sensor is thus determined, for example, by comparing its measured value with stored technological data for the pump.

- One advantageous refinement provides for the standardized output signal to be a 4 to
- 20 20 mA current loop signal and to provide the signal transmitter with power, as a result of which a particularly compact construction is achieved and the wiring complexity is reduced. A measured value is transmitted in an interference-proof manner using the current signal.

- 25 The refinement in which the sensors which are connected to the signal transmitter are in the form of pressure sensors for intake pressure and/or final pressure, in the form of a sensor for a pump differential pressure and/or in the form of sensors for detecting further measurement variables makes it possible, for example in the case of a pump, to determine, archive and display the operating point by measuring pressures on the
- 30 intake and pressure sides of said pump. This operating point can be displayed on the display of the integrated evaluation unit using a plurality of LEDs, for example. Provision is likewise made for a further sensor, for example a vibration pick-up, to be

connected. The measured values from said sensor may likewise be displayed on the display.

5 According to another refinement, the sensors can be identified by the signal transmitter by their own identification signals. After the sensors have been connected, the sensor type and measurement range are thus transmitted from said sensors to the signal transmitter. Alternatively, the connected sensors are connected to the signal transmitter by means of coded plug-in connections. One or more sensors may also be connected to the signal transmitter by means of a bus connection.

10

According to another refinement, rating plate data for the pump, rating plate data for the drive motor, hydraulic characteristic curves and regulating and/or diagnostic algorithms are stored in the memory apparatus. The memory apparatus contains, for example, characteristic points and/or support points of characteristic curves such as the
15 delivery head characteristic curve, which is called the Q-H characteristic curve, and/or the power characteristic curve, which is called the Q-P characteristic curve, and/or the NPSH characteristic curve of the pump. The technological data thus comprise values which can be used to calculate further characteristic variables of the centrifugal pump arrangement, for instance the operating point of the pump, with the aid of the measured
20 values.

According to an additional refinement, the signal transmitter has a memory apparatus for the operating data and operating states determined during operation of the centrifugal pump arrangement. As a result, the values calculated can be stored in the
25 memory apparatus and are thus available for immediate or subsequent evaluation or display.

A benefit to the customer results, in particular, from the fact that the memory apparatus is designed to store propagation time values, numbers of centrifugal pump starts and
30 load profile values for predefined different periods of time. The load profile derived from the operating points which are archived over the operating period of the pump thus allows conclusions to be drawn regarding the state of the pump.

The signal transmitter advantageously has an additional output for stored data for the centrifugal pump arrangement. Technological data for the pump and/or the drive motor, operating data and operating states can therefore be read out. A particularly compact construction is achieved by virtue of a sensor connection also being in the form of an output of the memory apparatus. An adapter cable can thus be connected to the signal transmitter instead of a pressure sensor on the intake side, for example for servicing purposes, and can be connected to a digital computer, a laptop or a pocket PC. Both the stored technological data for the pump and the calculated operating data and operating states of the centrifugal pump arrangement can thus be read out and evaluated.

In further refinements, the signal transmitter has a connection for connection to external devices, and/or connection to external devices is effected with or without lines or manually using a mobile transmission element. The technological data can be transmitted using a point-to-point connection with or without lines or a bus topology. Transmission using a mobile transmission element is a particularly flexible solution. For this purpose, the signal transmitter and/or the transmission element may have a transmission interface, advantageously a USB interface. In the case of a connection with lines, the output for the standardized output signal may be expediently used to connect external devices by means of a data bus.

The above refinements are particularly important if the external devices are drive, control, regulating, monitoring and/or diagnostic devices which, during automation of pumps, resort to a multiplicity of technological data for the respective pump in order to be able to apply matched, optimum drive, control, regulating, monitoring or diagnostic algorithms to the respective pump.

The stored data for the centrifugal pump arrangement are advantageously available to the external devices for automatic parameterization of the latter, for display and/or for further processing. As a result, all of the technological data for the centrifugal pump arrangement are available in situ and can be used for automatic parameterization of

any type of automation devices such as power electronic devices, switching devices, monitoring devices, diagnostic devices, control and regulating devices. External devices use these technological data to determine the required switching, regulating, monitoring or diagnostic operations for their operation. These technological data additionally form a basis for algorithms which are stored in switching, regulating, drive, monitoring or diagnostic devices and are intended for speed-regulated operation and/or diagnosis of the centrifugal pump arrangement. Complicated and error-prone manual input of technological data for the pump and/or the drive motor is dispensed with as a result of the refinement proposed. Multiple inputs are no longer required for a plurality of external devices.

The technological data are transmitted from the signal transmitter to an external device at the time of start-up. This eliminates the need to accurately assign the external device to the associated centrifugal pump arrangement as early as during manufacture. Automated transmission is simply activated by setting up a connection to the signal transmitter, if necessary even by means of a reset, or by means of trigger switches of the switching, regulating, drive, monitoring or diagnostic devices or of the mobile transmission element. Start-up is greatly simplified when a mobile transmission element is used since complicated setting-up of connections is dispensed with especially in the case of components which are physically far apart. A start-up engineer can read the technological data for the centrifugal pump arrangement into the transmission element and can transmit said data to other components.

A further advantage of this refinement is that a centrifugal pump arrangement provided with a signal transmitter can be extended in a flexible manner. When retrofitting external devices, for example automation devices, to a centrifugal pump arrangement which has already been installed, the technological data required by the external device are read from the memory apparatus of the signal transmitter and are transmitted to the external device. This greatly simplifies the operation of retrofitting an external device to an existing pump. A corresponding situation applies when replacing components, for example on account of maintenance work.

An advantageous method for transmitting measured values of a centrifugal pump arrangement using a signal transmitter according to the invention provides for the sensors to be identified by identification means, and for the evaluation unit to automatically process the measured values from the respective sensors and to display
5 measured values and/or calculated variables on the display. Measured values and/or calculated variables can be displayed in a cyclically alternating manner.

According to the invention, it is proposed that the microcomputer calculates, evaluates and stores operating data and operating states of the centrifugal pump arrangement
10 with the aid of the measured values and the stored data for the pump and/or the drive motor.

On account of the identification means, for example an identification signal or coded plug-in connections, the connected sensors provide the signal transmitter with a signal
15 which can be unambiguously assigned. A sensor may also be identified with the aid of data stored in the memory apparatus.

In the case of applications for which further analysis of the state of the centrifugal pump arrangement is required, a method, according to which propagation time values, numbers of centrifugal pump starts and/or load profile values are determined and
20 stored over predefined different periods of time, has proved to be worthwhile.

For servicing purposes, stored data such as technological data for the pump and/or the drive motor, operating data and operating states can be read out via an output.
25

In order to connect a signal transmitter according to the invention to external devices in a flexible manner, it is advantageous for data to be interchanged with external devices with or without lines or manually using a mobile transmission element.

30 The external devices preferably have access to the stored data for the centrifugal pump arrangement, are automatically parameterized using these data and/or use these data for display or further processing. Automated data transmission is activated by simply

setting up a connection to the signal transmitter, by means of a reset or by means of trigger switches.

Exemplary embodiments of the invention are illustrated in the drawings and are
5 described in more detail below. In the drawings:

fig. 1 shows a block diagram of a device according to the invention for transmitting
measured values, and

10 fig. 2 shows a centrifugal pump arrangement with an attached signal transmitter and
an additional external device.

Fig. 1 shows a block diagram of a device according to the invention for transmitting
measured values, having a signal transmitter 1 and an integrated evaluation unit 2. The
15 evaluation unit 2 has a microcomputer 3 and a display 4 for displaying measured
values and calculated variables. The signal transmitter 1 has two connections 5, 6 for
connecting sensors 7, 8 which are arranged on a centrifugal pump arrangement (not
illustrated here) with a pump and a drive motor. The sensors 7, 8 may be sensors for
intake pressure and final pressure of a pump. Alternatively, a sensor may be used for
20 the pump differential pressure. They may be standard sensors which are fitted to the
centrifugal pump arrangement, sensors which are integrated in the pump or motor or
external sensors which are connected to a system. The signal transmitter 1 is connected
to a power supply 9. A standardized output signal 10 from the signal transmitter 1 is
output at the same time as a 4 to 20 mA current loop signal via the power supply
25 connection 9. In this case, the connected sensors 7, 8 are connected to the signal
transmitter 1 by means of identification means in the form of coded plug-in
connections 11, 12. The identification means 13, 14 are symbolically illustrated in fig.
1 as a different form of connector. By virtue of its external shape and/or the formation
of its plug-in elements, a coded form of connector ensures an unmistakable connection
30 between an individual sensor and the connections on the signal transmitter 1. This
makes it possible to preclude mixing up of the sensor connections. In accordance with
a defined allocation of individual plug-in elements of a connector having a multiplicity

of plug-in elements, a defined assignment of the sensor and sensor measurement range with respect to the signal transmitter is achieved even in the case of a standard connector. In the case of sensors 7, 8 which are provided with integrated identifiers, electronic identification means 15, 16 are transmitted to the signal transmitter 1 as
5 identification signals. The signal transmitter 1 is thus provided with knowledge of the type and measurement range of the connected sensors 7, 8 with the aid of the identification means 13 to 16. As a result, the signal transmitter 1 does not require any operating elements and is ready for operation by simply connecting the connections. Identification means which are arranged inside the signal transmitter, for example in
10 the evaluation unit, and assign the sensor and sensor measurement range in a defined manner using data which are stored in the signal transmitter are provided as alternative identification means according to the invention.

Technological data for the pump and/or the drive motor are stored in a memory
15 apparatus 17 of the signal transmitter 1. The microcomputer 3 calculates operating data and operating states of the centrifugal pump arrangement with the aid of the measured values from the sensors 7, 8 and the data stored in the memory apparatus 17. In this case, the memory apparatus 17 is additionally used to store operating data and operating states determined during operation of the centrifugal pump arrangement.
20 Measured values and/or calculated variables are displayed on the display 4 in a cyclically alternating manner. In order to display the state of the signal transmitter 1 and the state of a centrifugal pump arrangement according to a "good" state, a warning or an alarm, two multicolored LEDs 18, 19 are additionally arranged on the display. Such states can be signaled by means of a color change like a traffic light display.
25 Further displays, for example a display of sensor faults or an illustration of the operating points in the form of a characteristic curve, can likewise be achieved on the display or using other signal elements. Alternatively, measured values and/or calculated variables are permanently displayed.

30 Measured values from individual sensors of the centrifugal pump arrangement can be transmitted to external devices in an interference-proof manner using the analog output signal 10. Stored data for the pump and/or the drive motor and/or operating data and

operating states can be read from the signal transmitter using the sensor connection 5. An adapter cable is connected instead of a sensor 7, and a connection to a digital computer, laptop or pocket PC is thus set up by the signal transmitter 1. For servicing purposes, rating plate data for the pump, rating plate data for the motor, a delivery head characteristic curve, a power characteristic curve, an NPSH characteristic curve, the propagation time of the arrangement in different periods of time, the number of starts in different periods of time and a load profile in the form of a histogram of the operating points over different periods of time can thus be read out, inter alia. Intended operation of a pump can thus be assessed at the installation location. Furthermore, these data are available for investigating the cost-effectiveness of retrofitting the centrifugal pump arrangement with automation devices.

In the exemplary embodiment, the signal transmitter 1 is also provided with a further transmission interface 20 for communicating with a digital computer or a mobile transmission element, for example a USB stick.

In the illustration, two sensors 7, 8 are connected to the signal transmitter 1 by way of example. Further sensors such as temperature pick-ups, vibration pick-ups or sensors for sealing leaks may also be optionally connected by means of further connections. The measured values from such additional sensors are then likewise displayed on the display 4 of the signal transmitter 1.

Fig. 2 shows a centrifugal pump arrangement 21 with a pump 22 and a drive motor 23. A signal transmitter 1 is fitted to the pump 22 and is connected to the sensors for intake pressure 7 and final pressure 8. The signal transmitter 1 is internally provided with the memory apparatus 17 which stores pump-specific data such as the rated speed of the pump, its minimum and maximum delivery rate and its permissible bearing temperature. Furthermore, the Q-H characteristic curve and the Q-P characteristic curve of the pump are stored in the memory apparatus. The signal transmitter 1 has a display 4 for displaying pictograms, values and units of measurement variables, such as intake pressure, final pressure, calculated variables, such as delivery head and the

operating point of the pump which is estimated with the aid of the stored delivery head characteristic curve, and for displaying warnings and alarms.

In the refinement shown here, the output signal 10 is a data bus signal and is
5 transmitted to an additional external device 24 - a frequency converter in this case -
using a data bus connection 25. The signal transmitter 1 and the sensors 7, 8 are
supplied with power via the automation device 24. The measured values from all of the
sensors connected to the signal transmitter 1 can be transmitted to the automation
device 24 using the data bus connection 25, can be displayed and can be processed
10 further as regulating or diagnostic variables and/or can be used for transmission on a
field bus. In addition, all of the stored technological data for the pump 22 and/or the
drive motor 23, that is to say all pump-specific and/or motor-specific characteristic
variables such as hydraulic characteristic curves, permissible bearing temperature or
regulating and/or diagnostic algorithms can be read from the memory apparatus 17
15 (not illustrated here) of the signal transmitter 1 by the automation device 24. This
makes it possible for the automation device 24 to be automatically parameterized by
the signal transmitter 1.

P A T E N T K R A V

1. Indretning til måleværdioverførsel, hvilken har et sensormodul, der består af miniaturiserede komponenter, hvor sensormodulet er anbragt på et centrifugalpumpeaggregat med en pumpe og en drivmotor, og en evalueringsenhed, hvor sensormodulet omfatter tilslutninger til eventuelle sensorer, hvor sensormodulet kan forbindes til en eller flere sensorer, som registrerer driftstilstandene for centrifugalpumpeaggregatet med pumpen og drivmotoren som måleværdier, og hvor sensormodulet omfatter en tilslutning til en strømforsyning, og behandler måleværdierne,
 k e n d e t e g n e t ved, at sensormodulet identificerer sensorerne (7, 8) ved hjælp af identifikationsmidler, at sensormodulet er udformet som en signalsender (1) med et standardiseret udgangssignal (10),
 at evalueringsenheden (2) omfatter en mikrocomputer (3), er integreret i sensormodulet, og er udformet med et display (4),
 og at evalueringsenheden (2) behandler måleværdierne, og viser måleværdierne og/eller beregnede variabler på displayet (4), og at signalsenderen (1) omfatter en lageringsindretning (17) med tekniske data om pumpen (22) og/eller drivmotorerne (23),
 hvor mikrocomputeren (3), ved hjælp af måleværdierne og de lagrede data beregner, og evaluerer driftsdata og driftstilstande for centrifugalpumpeaggregatet (21).
2. Indretning til måleværdioverførsel ifølge krav 1, k e n d e t e g n e t ved, at evalueringsenheden (2) cyklisk alternerende viser måleværdier og/eller beregnede variabler på displayet (4).
3. Indretning til måleværdioverførsel ifølge krav 1 eller 2, k e n d e t e g n e t ved, at signalsenderen (1) omfatter tilslutninger (5, 6) til sensorer (7, 8) for indsugningstryk og/eller sluttryk, til en pumpedifferenstryksensor og/eller til sensorer for registrering af flere målevariabler.
4. Indretning til måleværdioverførsel ifølge krav 1, 2 eller 3, k e n d e t e g n e t ved, at sensorerne (7, 8) kan identificeres af signalsenderen (1) ved egne identifikations-signaler (15, 16) og/eller kodede stikforbindelser, og/eller at der er tilvejebragt identifikationsmidler anbragt i signalsenderen (1).
5. Indretning til måleværdioverførsel ifølge et hvilket som helst af kravene 1 til 4, k e n d e t e g n e t ved, at der i lagringsindretningen (17) er lagret mærkedata for pumpen (22), mærkedata for driftsmotorerne (23), hydrauliske karakteristikker samt styrings- og/eller diagnosticeringsalgoritmer.
6. Indretning til måleværdioverførsel ifølge et hvilket som helst af kravene 1 til 5, k e n d e t e g n e t ved en lageringsindretning (17) til de driftsdata og driftstilstande, der detekteres under driften af centrifugalpumpeindretningen (21).
7. Indretning til måleværdioverførsel ifølge krav 6, k e n d e t e g n e t ved, at lageringsindretningen (17) er konstrueret til at lagre løbetidsværdier, antallet af centrifugalpumpestarter samt lastkollektivværdier for forskellige forudbestemte tidsrum.

8. Indretning til måleværdioverførsel ifølge et hvilket som helst af kravene 1 til 7, k e n d e t e g n e t ved en yderligere udgang til de lagrede data for centrifugalpumpeaggregatet.

9. Indretning til måleværdioverførsel ifølge et hvilket som helst af kravene 1 til 8, k e n d e t e g n e t ved en tilslutning til at forbinde til eksterne apparater (24).

10. Indretning til måleværdioverførsel ifølge krav 9, k e n d e t e g n e t ved, at udgangen for det standardiserede udgangssignal (10) er anvendt til tilknytning af eksterne apparater (24) ved hjælp af en databus (25).

11. Indretning til måleværdioverførsel ifølge krav 9 eller 10, k e n d e t e g n e t ved, at de lagrede data for centrifugalpumpeaggregatet står til rådighed til for de eksterne apparater (24) til automatiske parametrisering, til visning og/eller til viderebehandling.

12. Fremgangsmåde til måleværdioverførsel for et centrifugalpumpeaggregat under anvendelse af en indretning til måleværdioverførsel ifølge et hvilket som helst af kravene 1 til 11, k e n d e t e g n e t ved, at sensorerne (7, 8) identificeres ved identifikationsmidler (13, 14, 15, 16),

at evalueringsenheden (2) automatisk behandler måleværdierne fra hver af sensorerne (7, 8), og viser måleværdier og/eller beregnede variabler på displayet (4), og at mikro-computeren (3) med hjælp fra måleværdierne og de lagrede data for pumpen (22) og/eller driftsmotoren (23) beregner, evaluerer, og lagrer driftsdata og driftstilstande for centrifugalpumpeaggregatet (21).

13. Fremgangsmåde ifølge krav 12, k e n d e t e g n e t ved, at displayet (4) cyklisk alternerende viser måleværdier og/eller beregnede variabler.

14. Fremgangsmåde ifølge krav 12 eller 13, k e n d e t e g n e t ved, at løbetidsværdien, antallet af centrifugalpumpestarter og/eller lastkollektivværdierne bestemmes og lagres over forskellige forudbestemte tidsrum.

15. Fremgangsmåde ifølge et hvilket som helst af kravene 12 til 14, k e n d e t e g n e t ved, at der udlæses lagrede data via en udgang.

16. Fremgangsmåde ifølge et hvilket som helst af kravene 12 til 15, k e n d e t e g n e t ved, at der sker en dataudveksling med de eksterne apparater (24) med en ledning, uden en ledning eller manuelt med et mobilt overførselselement.

17. Fremgangsmåde ifølge et hvilket som helst af kravene 12 til 16, k e n d e t e g n e t ved, at den eksterne apparater (24) har tilgang til de lagrede data for centrifugalpumpeaggregatet, der automatisk parameteriseres med disse data og/eller disse data benyttes til visning eller viderebehandling.

18. Fremgangsmåde ifølge et hvilket som helst af kravene 12 til 17, k e n d e t e g n e t ved, at der aktiveres en automatiseret dataoverførsel ved oprettelse af en forbindelse med indretningen til måleværdioverførsel (1), ved genstart eller med en udløsekontakt.

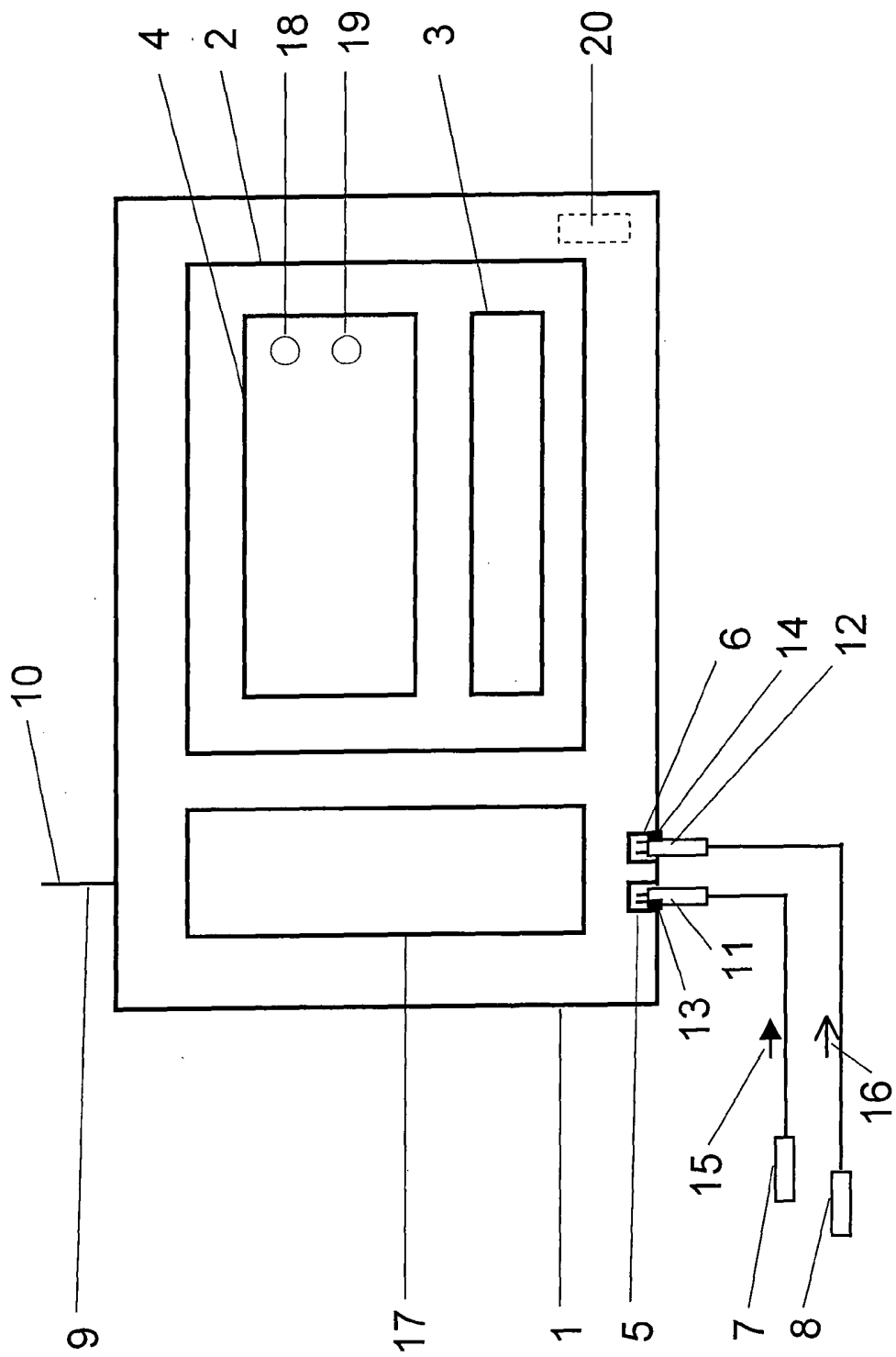


Fig. 1

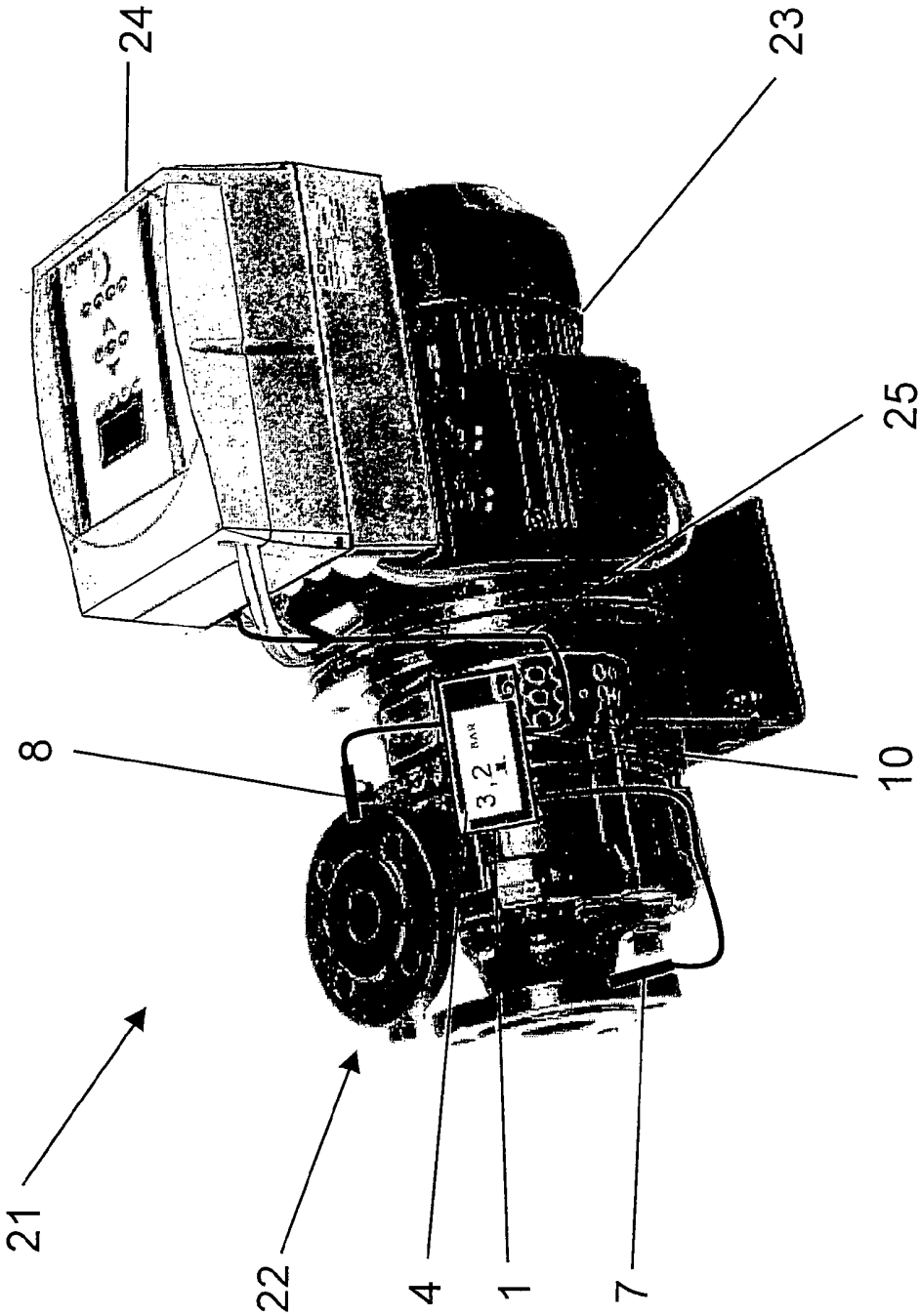


Fig. 2