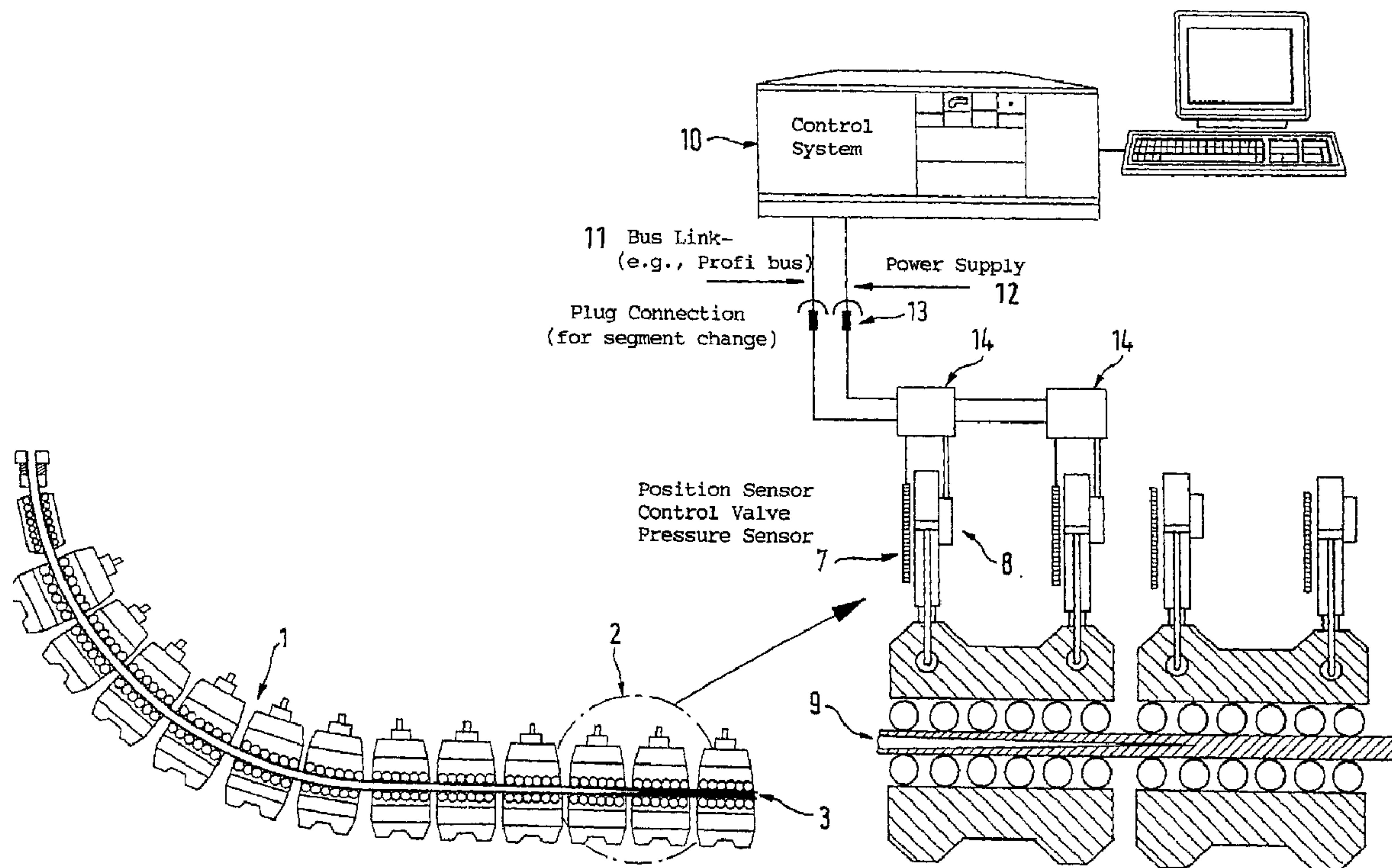




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 (54) Title: FEED OPENING ADJUSTMENT OF SEGMENTS FOR CONTINUOUS CASTING SYSTEMS



(57) **Abrégé/Abstract:**

The invention relates to a method for adjusting the feed opening of segments for continuous casting systems, especially position-controlled segments for slab and thin-slab continuous casting systems which comprise a strand guide (1) with segments (2) for a predetermined guidance of a cast strand using measuring and control signals. In order to provide an independent intelligent segment, the measuring and control signals are processed in at least one system unit (14) directly on the respective segment (2) and the set values are fed to the segment (2) by a superordinate control system (10) via a field bus (11), for example a profibus and a power supply (12). Actual values are returned to the control system (10) via the field bus (11) as the result of control or as a

(57) **Abrégé(suite)/Abstract(continued):**

process status. The system units (14) present on the segment (2) are supplied with segment-specific data such as rigidity coefficients, roller diameter, control parameters, feed opening basic settings and adjustment quota. The invention also relates to a device for carrying out the method.

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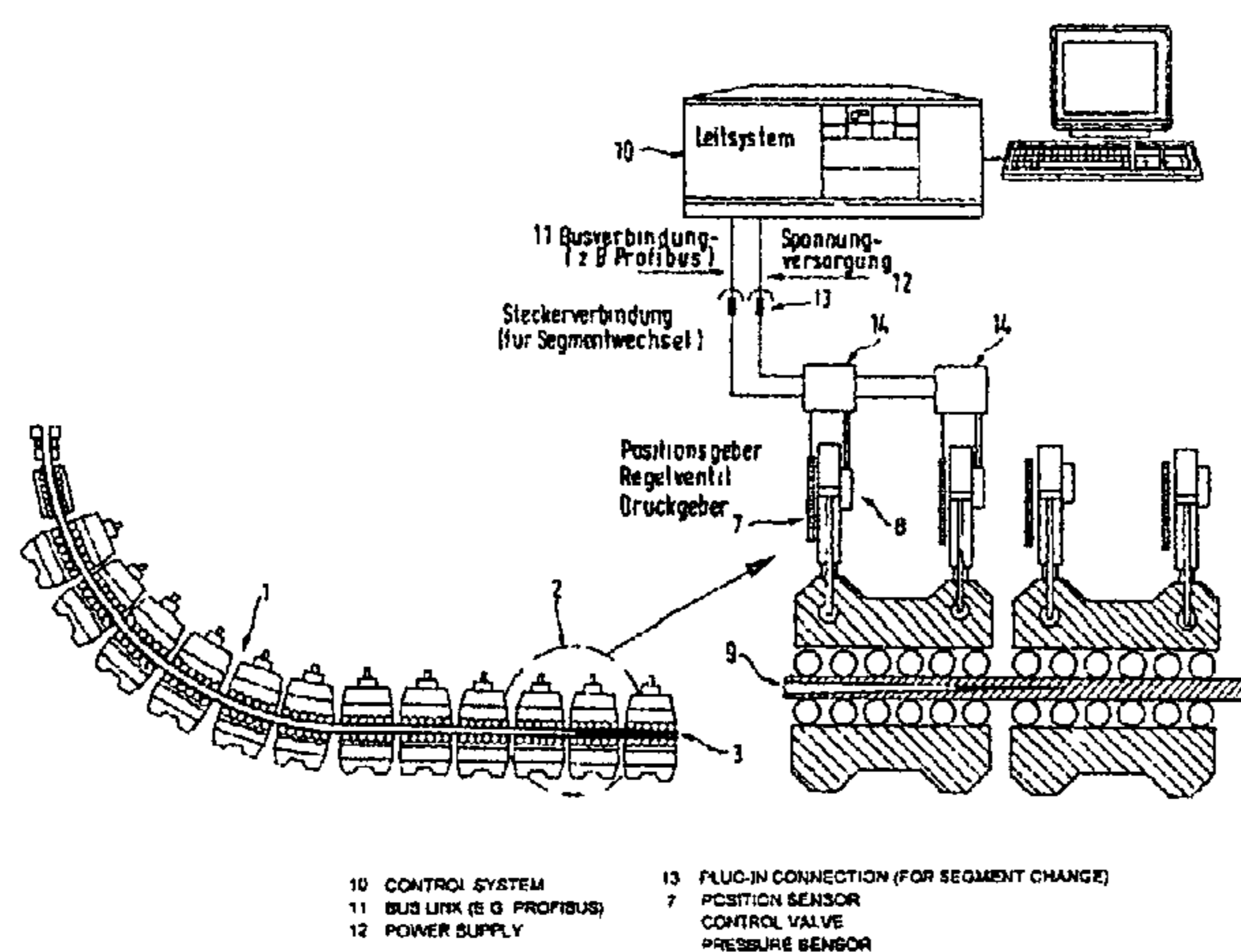
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[Fortsetzung auf der nächsten Seite]

(54) Title: FEED OPENING ADJUSTMENT OF SEGMENTS FOR CONTINUOUS CASTING SYSTEMS

(54) Bezeichnung: MAULWEITENREGELUNG AN SEGMENTEN FÜR STRANGGIESSANLAGEN



(57) Abstract: The invention relates to a method for adjusting the feed opening of segments for continuous casting systems, especially position-controlled segments for slab and thin-slab continuous casting systems which comprise a strand guide (1) with segments (2) for a predetermined guidance of a cast strand using measuring and control signals. In order to provide an independent intelligent segment, the measuring and control signals are processed in at least one system unit (14) directly on the respective segment (2) and the set values are fed to the segment (2) by a superordinate control system (10) via a field bus (11), for example a *profibus* and a power supply (12). Actual values are returned to the control system (10) via the field bus (11) as the result of control or

as a process status. The system units (14) present on the segment (2) are supplied with segment-specific data such as rigidity coefficients, roller diameter, control parameters, feed opening basic settings and adjustment quota. The invention also relates to a device for carrying out the method.

(57) Zusammenfassung: Die Erfindung betrifft ein Verfahren zur Maulweitenregelung an Segmenten für Stranggießanlagen, insbesondere an positionsgeregelten Segmenten für Brammen- und Dünnbrammen-Stranggießanlagen, umfassend eine Strangführung (1) mit Segmenten (2) für eine vorgesehene Führung eines Gußstranges unter Verwendung von Meß- und Regelsignalen, um ein unabhängiges intelligentes Segment zu schaffen, ist vorgesehen, dass die Meß- und Regelsignale in mindestens einer Systemeinheit (14) unmittelbar auf dem jeweiligen Segment (2) verarbeitet und die SOLLwert-Vorgaben von einem übergeordneten Leitsystem (10) über einen Feldbus (11), z.B. Profibus und eine Spannungsversorgung (12) dem Segment (2) zugeführt werden, sowie ISTwert-Daten ebenfalls über den Feldbus (11) dem Leitsystem (10) als Regelergebnis bzw. Prozeßzustand zurückgeführt werden. Den auf dem Segment (2) befindlichen System-einheiten (14) werden segmentspezifische Informationen wie Steifigkeitskoeffizienten, Rollendurchmesser, Reglerparameter, Maulweitengrundeinstellungen und Anstellquoten zugeführt. Die Erfindung betrifft auch eine Vorrichtung zur Durchführung des Verfahrens.

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**Translated Text of WO 03/051,558 A2 (PCT/EP02/12693)
with Amended Claim Incorporated Therein**

**Feed Opening Adjustment of Segments for Continuous
Casting Systems**

The invention concerns a device for automatically controlling the feed opening of segments for continuous casting plants, which are designed at least with a position sensor and a pressure sensor, especially for automatically controlling the feed opening of segments for slab and thin-slab continuous casting plants, which comprise a strand guide with segments for predetermined guidance of a cast strand with the use of measuring signals and automatic control signals. The invention also concerns the use of the device.

The prior art includes position-controlled and pressure-controlled segments (segment cylinders) in continuous casting plants. In the prior art, the feed opening is adjusted by hydraulic cylinders and measuring/automatic control devices and regulation devices that can be assigned to them, especially for use in soft-reduction (SR) and liquid-core-reduction (LCR) processes.

The automatic control and regulation devices necessary for this are usually located in remote switching equipment of the continuous casting plants.

The automatic control and/or regulation breaks down if there is a failure of the transmission devices or transmission lines.

The document DE 100 28 304 A1 discloses a method and a device for decentralized casting data processing of the measurement data acquired by sensors at a continuous casting mold in a process computer of a continuous casting plant. This previously known development is based on the objective of more efficient electronic processing of, among other things, the casting data measured by sensors and on the further objective of using this more efficient electronic processing to simplify the equipment provided for this purpose. To this end, the measuring and control data are collected in cooled field bus modules directly on the continuous casting mold and converted to bus signals in a bus line and at least stored and/or processed in the control system of the continuous casting plant. This greatly reduces and simplifies the data flow path and also simplifies the equipment.

Another advantage of this development results from the fact that mold-specific information, e.g., on the thickness of the copper plates, the degree of erosion, the condition of the heat sensors and/or the resistance heat sensors, and the maintenance cycles, can be stored in and retrieved from the field bus modules on the continuous casting mold.

The document WO 99/46,071 discloses an adjustment method for a roller segment of a continuous casting plant, which has a segment inlet side, a segment outlet side, and a pair of roller supports, each of which supports at least two rollers that extend over a support area. The roller supports are mutually adjusted by an adjusting unit installed on the segment inlet side and another installed on the segment outlet side. Each adjusting unit has two hydraulic cylinder units installed on either side of the support area.

In the adjustment method known from this document, the hydraulic cylinder units can be adjusted by both position control and pressure control, the rollers can be adjusted by the hydraulic cylinder units via position control to a strand of metal guided by the rollers, and the hydraulic cylinder units can be switched from position-controlled to pressure-controlled

operation if the pressure in the given hydraulic cylinder unit reaches a limit value.

Proceeding on the basis of the aforementioned prior art, the objective of the invention is to install a decentralized automatic control and regulation system with suitable modules directly on a segment or directly on a hydraulic cylinder to create an "intelligent" segment that ensures continued operation even in the event of a loss of communication data.

In accordance with the invention, this objective is achieved with a device in which each segment has at least one decentralized system unit, which is connected with an overriding control system and a power supply via a field bus or profi bus.

Besides a design of the system unit with control and regulation units on the segment, an alternative design with so-called intelligent terminals on the segment to reduce the amount of cabling is possible.

With respect to the use of the device of the invention, it is proposed that the measuring and automatic control signals are processed in at least one system unit directly on the given segment, the predetermined set point values are fed to the

segment by an overriding control system via a field bus, e.g., a profi bus, and actual values are returned to the control system, likewise via the field bus, as control results or as the process status.

With respect to the use of the invention, it is further provided that, besides the necessary function(s) for accomplishing the segment adjustment, the decentralized system unit is assigned additional decentralized segment-specific functions, such as acquisition and processing of other measurement data, e.g., bearing force monitoring, temperature measurements and controls, and calibration data.

The measures in accordance with the invention enable the segment, even in the event of loss of communication with the control system, to independently control the data that has been set or the data stored in the control module, e.g., for the desired position or for the desired force value that has been set. The battery unit required for bridging the communication failure is also located on the segment.

Another advantage that is gained at the same time is a reduction of the electric plug connections between the segment

and the control system, which results in a reduction of the segment changing times.

In one aspect of the present invention, there is provided a device for automatically controlling the feed opening of segments for continuous casting plants, which are designed at least with a position sensor and a pressure sensor, especially for automatically controlling the feed opening of segments for slab and thin-slab continuous casting plants, which comprise a strand guide with segments for predetermined guidance of a cast strand with the use of measuring signals and automatic control signals, characterized by the fact that each segment has at least one decentralized system unit, which is connected via a field bus or profi bus with an overriding control system and a power supply.

In another aspect of the present invention, there is provided a device for automatically controlling the feed opening of segments for continuous casting plants, which are designed at least with an associated position sensor and an associated pressure sensor, especially for automatically controlling the feed opening of segments for slab and thin-slab continuous casting plants, which comprise a strand guide with segments for predetermined guidance of a cast

strand with the use of measuring signals and automatic control signals, characterized by the fact that each segment has at least one decentralized system unit operable to communicate with said associated position and pressure sensors for processing said measuring and automatic control signals, and wherein the at least one decentralized system unit is connected via one of a field bus and profi bus with an overriding control system and a power supply wherein the control system is operable to communicate predetermined set point values to the at least one system unit.

An embodiment in accordance with the state of the art is described below with reference to Figure 1, and an embodiment of the object of the invention is described with reference to Figure 2.

Figure 1 shows a strand guide 1 of well-known design, which comprises a number of strand guide segments 2, which safely guide the strand 3 from the point at which it leaves the mold with increasing solidification through the areas of soft reduction or liquid core reduction.

The segments 2 (shown enlarged) are provided with hydraulic adjusting devices, which in turn are equipped with a position sensor 7 and preferably a pressure sensor 8. These are position-controlled and pressure-controlled segments 2,

whose feed openings and position can be adjusted by means of hydraulic cylinders and associated measuring/automatic control devices and regulation devices according to predetermined set points. The automatic control system for this is located in remote equipment or switching stations 4 of the continuous casting plant.

In contrast to the state of the art, the embodiment of the strand guide in accordance with the invention, which is equipped at least with an independent position sensor 7 and pressure sensor 8 and is preferably connected by a bus link 11 or a profibus with an overriding control system 10 and a power supply 12. The lines present for this with plug connections 13 require only a fraction of the line system 5 with plug connections 6 in the state-of-the-art embodiment shown in Figure 1. Another decisive advantage results from the fact that in the event of a failure of the transmission lines or connection devices, the automatic control or regulation does not break down due to its self-sufficient position on the segments. Instead of the automatic control and regulation units on the segment 2, so-called intelligent terminals can be provided as an advantageous alternative solution.

List of Reference Numbers

- 1 strand guide
- 2 segment
- 3 cast strand
- 4 central control
- 5 lines
- 6 plug connections of (5)
- 7 position sensor
- 8 pressure sensor
- 9 liquid core in the strand
- 10 control system
- 11 field bus/profi bus
- 12 power supply
- 13 plug connections in 11/12
- 14 decentralized automatic controller

CLAIMS

1. Device for automatically controlling the feed opening of segments for continuous casting plants, which are designed at least with an associated position sensor (7) and an associated pressure sensor (8), especially for automatically controlling the feed opening of segments for slab and thin-slab continuous casting plants, which comprise a strand guide (1) with segments (2) for predetermined guidance of a cast strand with the use of measuring signals and automatic control signals, characterized by the fact that each segment (2) has at least one decentralized system unit (14) operable to communicate with said associated position and pressure sensors for processing said measuring and automatic control signals, and wherein the at least one decentralized system unit is connected via one of a field bus and profi bus (11) with an overriding control system (10) and a power supply (12) wherein the control system is operable to communicate predetermined set point values to the at least one system unit.

2. Device in accordance with claim 1, characterized by the fact that the lines for bus links (11) and for the power supply (12) are equipped with plug connections for the purpose of making segment changes.

3. Device in accordance with Claim 1 or Claim 2, characterized by the fact that the system units (14) are automatic control and regulation units.

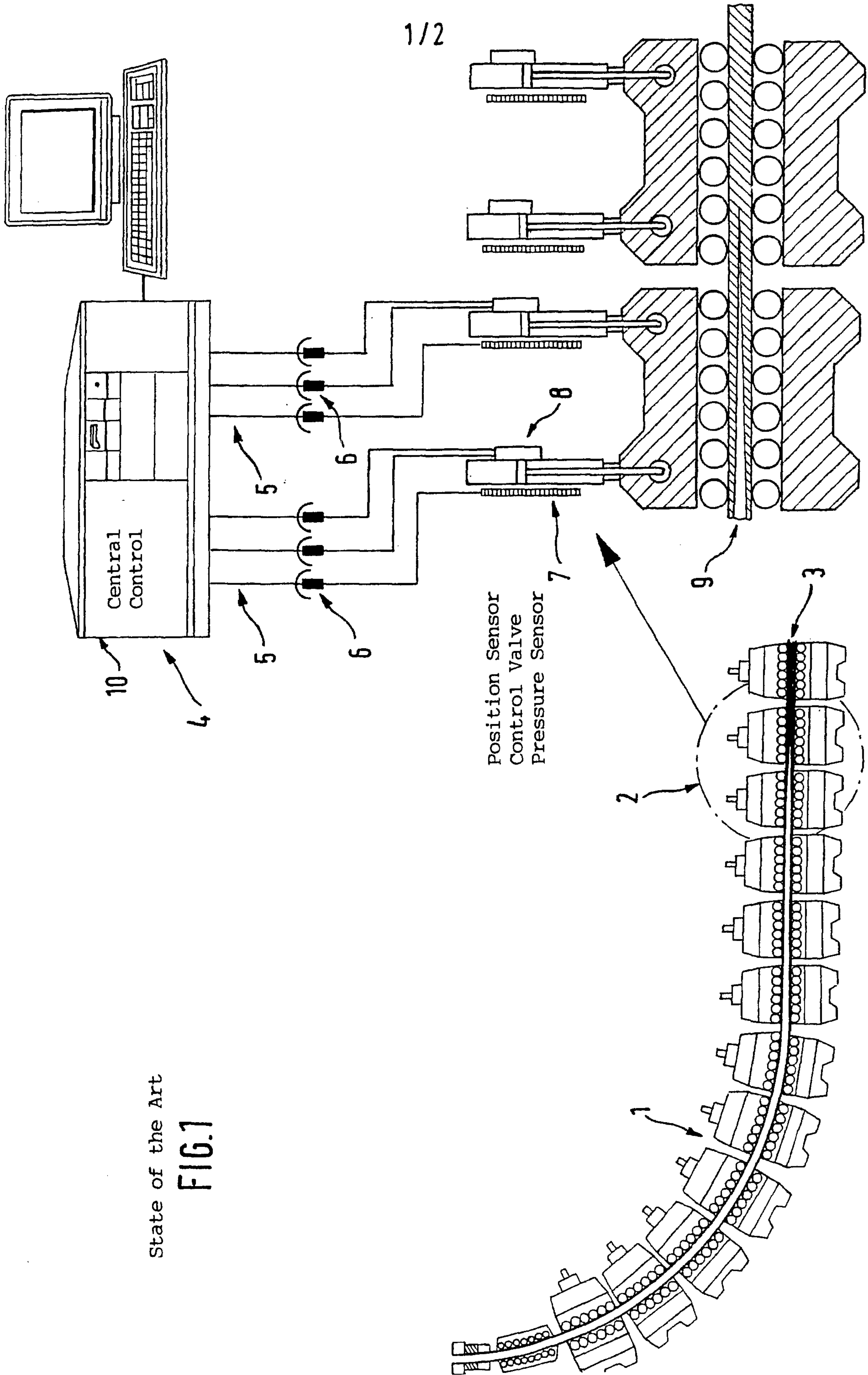
4. Device in accordance with any one of Claims 1 to 3, characterized by the fact that the system units (14) comprise intelligent terminals.

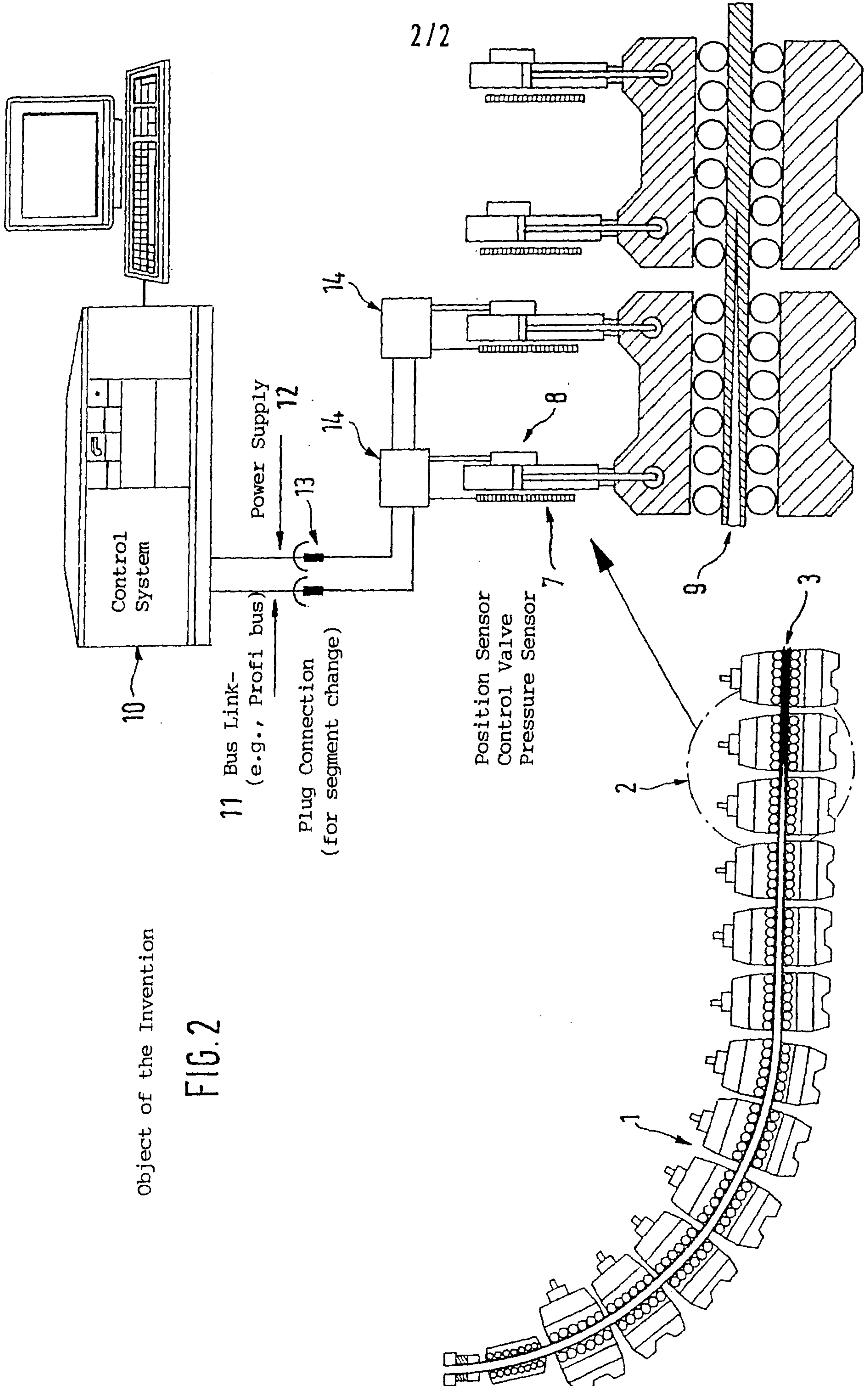
5. Use of the device for automatically controlling the feed opening of segments for continuous casting plants, especially segments for slab and thin-slab continuous casting plants, in accordance with any one of Claims 1 to 4, characterized by the fact that the measuring and automatic control signals are processed in the at least one decentralized system unit (14) directly on the given segment (2), the predetermined set point values are fed to the segment (2) by the overriding control system (10) via one of said field bus (11), and profi bus, and said power supply (12); wherein actual values are returned to the control system (10) via one of said field bus (11) and profi bus as control results or as a process status.

6. Use of the device in accordance with Claim 5, characterized by the fact that segment-specific data selected from the group consisting of modulus of elasticity in shear,

roller diameter, automatic controller parameters, basic settings of the feed opening and adjustment ratios, are supplied to the system units (14) located on the segment (2).

7. Use of the device in accordance with Claim 5 or Claim 6, characterized by the fact that, besides the necessary function(s) for accomplishing the segment adjustment, the decentralized system unit (14) is assigned additional decentralized segment-specific functions selected from the group consisting of acquisition and processing of other measurement data, bearing force monitoring, temperature measurements, temperature controls and calibration data.





Object of the Invention

FIG. 2

