



- 2. März 1984

CERTIFICATE OF GRANT OF UNITED KINGDOM PATENT

In accordance with section 24(2) of the Patents Act, 1977, it is hereby certified that a patent having the specification No. 2042738 has been granted to Glotzl Gesellschaft Fur Baumesstechnik mbH (FR Germany) in respect of an invention disclosed in an application for that patent having a date of filing of 28 February 1979 being an invention for "An extensometer arrangement for rock and soil mechanics".

Dated this Eighth day of February, 1984

A handwritten signature in dark ink, appearing to read 'Ivor Davis'.

IVOR DAVIS

Comptroller-General of Patents
Designs and Trade Marks

THE ATTENTION OF THE PROPRIETOR IS DRAWN TO THE IMPORTANT NOTES OVERLEAF

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A 059896

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(12) UK Patent (19) GB (11) 2 042 738 B

(54) Title of invention
An extensometer arrangement for rock and soil mechanics

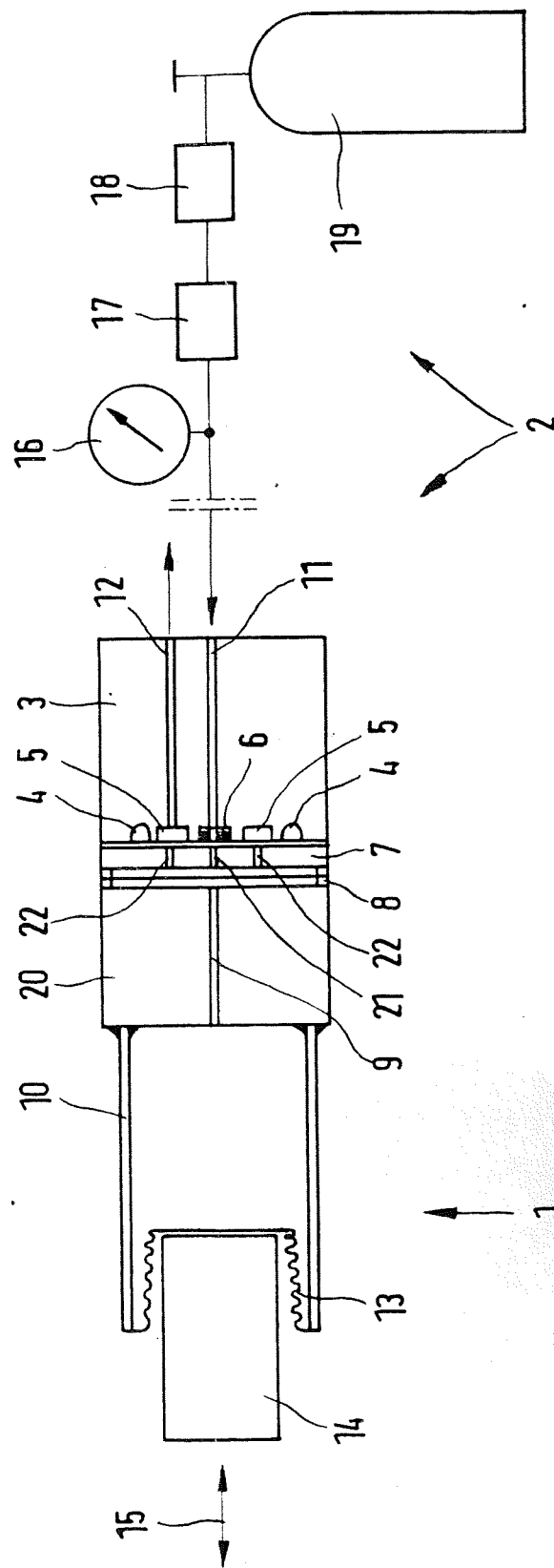
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<p>(52) Domestic classification G1S 1D 1E1 4A G1M 1A4 1H</p> <p>(56) Documents cited GB 1106888 GB 1173956 GB 996860</p> <p>(58) Field of search G1M G1S</p>	<p>(74) Agent and/or Address for Service Sydney E. M'Caw and Co., 41-51 Royal Exchange, Cross Street, Manchester M2 7BD</p>
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2042738



AN EXTENSOMETER ARRANGEMENT FOR ROCK AND SOIL MECHANICS

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The invention relates to an extensometer arrangement of the type for measuring and monitoring movements in rock and soil having at least two steel rods arranged to be 5. anchored at different positions in the ground, and a measuring system for use in determining relative axial movement of the rod heads.

In rock and soil strata it is important to be able to measure the vertical (axial) and horizontal (radial) move- 10. ments and displacements. As a rule it is not absolute values which are determined but the relative values of displacement movements. For ascertaining these movements several steel rods or bracing wires let into the rock or soil strata are used, such rods or wires being anchored by 15. means of concrete injections at different positions in the ground so as to follow the strata movements. The relative movements and relative paths are transmitted to the extensometer head by the steel rods and can be sensed and read there mechanically with a measuring clock. If the extenso- 20. meter head is located at an inaccessible place for example on a rock slope or even under water then remote control measuring is necessary which involves electrical measuring apparatus. In this case the measurement value transmission must also be carried out by electrical means. These devices 25. are sensitive and expensive in particular when under water measurements are to be carried out.

The invention is based on the problem of designing an extensometer arrangement of the abovementioned type in particular for remote control measuring such that no electrical constructional parts are necessary.

5. The solution according to the invention is characterised in that said measuring system comprises a respective capping device associated with the head of each steel rod for producing a hydrostatic pressure representative of axial movement of the rod, a measuring device associated with
10. said capping device and in which said hydrostatic pressure is arranged to be compensated by pressure of a fluid fed to said measuring device, and apparatus for measuring the pressure of said fluid.

- With the invention, axial movement of each steel rod
15. is represented by a hydrostatic pressure and this pressure is ascertained by a compensation measurement. The measuring system therefore operates by hydro-mechanical means and consequently the more simple mechanical constructional parts can be used which in addition even with underwater operation
20. may be insensitive. The remote transmission of measurement values also does not thereby present any problems. For the transmission of measurement values plastics pipes can be used which compared with electrical cables have higher traction and sheer strength and a higher degree of elongation
25. so that even with

difficult terrain conditions and stresses there is little tendency for breakdowns to occur.

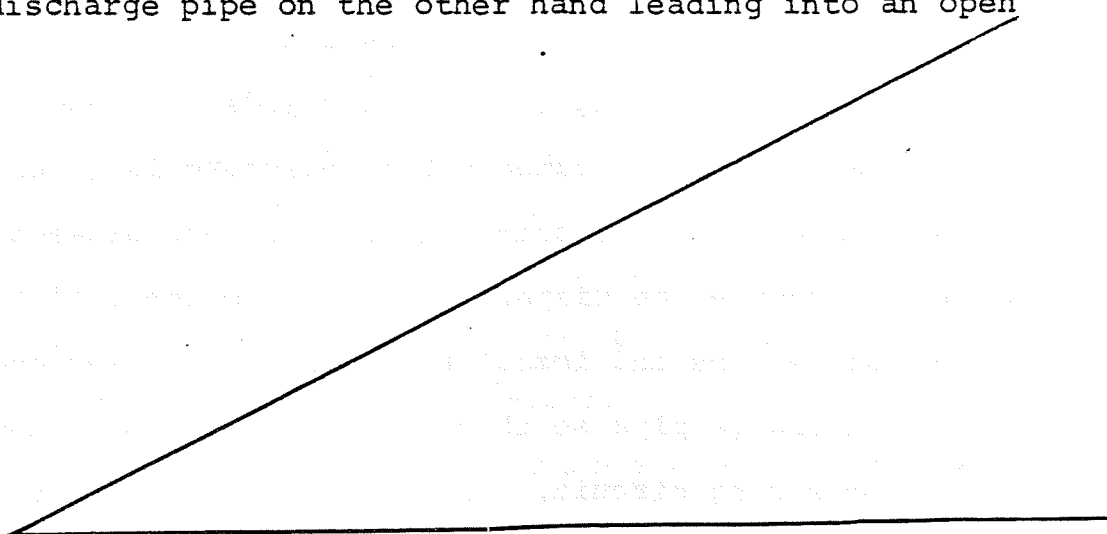
- A preferred embodiment of the invention is characterised in that the capping device has a piston and
5. cylinder unit connected to the head of the steel rod and the measuring device has a fluid circuit with a pressure pipe and a flow-off or discharge pipe parallel thereto, and that between the piston and cylinder unit on the one hand and the outlet of the pressure pipe and
 10. discharge pipe on the other hand a diaphragm valve is disposed the diaphragm of which is stressed on one side by the pressure of the cylinder whilst with the other side it closes at the same time an outlet of the pressure pipe and an inlet opening of the discharge pipe.
 15. The diaphragm valve operates therefore like an overflow valve in which the diaphragm normally holds closed the outlet of the pressure pipe and the inlet opening of the discharge pipe due to the pressure of the piston and cylinder unit remaining on its other side. If now via
 20. the pressure pipe the compensation pressure is given then at the moment when the compensation pressure exceeds the loading pressure the diaphragm lifts from the outlet of the pressure pipe and immediately frees the inlet opening of the discharge pipe so that fluid can flow over and out
 25. of the measuring circuit. The pressure in the measuring circuit reached at this moment can be ascertained in

conventional manner by pressure gauges or the like and this gives a pressure representative of the position of the piston in the cylinder and the path of the steel rod.

5. The piston and cylinder unit consists advantageously of a piston fixed on the head of a steel rod and a cylinder connected to this via an elastic bellows, the head of the cylinder having a bore which connects the cylinder space to one side of the diaphragm. Thereby it
10. is possible to keep the space lying on this side of the diaphragm small so that the rate of delivery of the cylinder does not have to be so high.

It may furthermore be advantageously arranged that the pressure pipe and the discharge pipe of the measuring

15. device are disposed parallel to one another in a measuring head, the pressure pipe leading out directly but the discharge pipe on the other hand leading into an open



annular channel on a front side of the measuring head, and between this front side of the measuring head and the diaphragm a valve disc being disposed which has a bore flush with the outlet of the pressure pipe and at least
5. two further bores connecting the annular channel to the diaphragm.

With this construction, the advantage may be achieved that even with not absolutely symmetrical curvature of the diaphragm it may always be ensured that the fluid used for
10. the compensation measurement when it has just lifted the diaphragm can flow through one of the bores to the discharge pipe. Preferably the pressure pipe leads through the centre of the annular channel.

A particularly favourable construction results if the
15. cylinder with its head, the diaphragm valve, the valve body and the measuring head are combined to form a rigid unit whilst the cylinder is connected via the elastic bellows and the measuring head is connected via the plastics pipes to a pressure medium source and the pressure measuring
20. apparatus. Such a unit can be easily mounted on the head of the extensometer steel rod and connected with the measuring device.

The invention will now be described further by way of example only and with reference to the accompanying drawing
25. which is a diagram showing one rod and associated parts of a measuring system of one form of an extensometer arrangement according to the invention.

The extensometer arrangement has two or more steel rods anchored in the ground at different positions, which steel rods are known in the art and are not illustrated in the drawing. The direction of relative movement of the 5. rods to be measured is indicated with the double arrow 15. Furthermore, the extensometer arrangement has a capping device 1 which produces a hydrostatic pressure representative of the movement of an extensometer steel rod indicated by means of the double arrow 15, and a measuring device 2 by 10, means of which the pressure produced by the capping device 1 is compensated and measured.

The measuring device 2 has a measuring head 3 in which are disposed a pressure pipe 11 and parallel thereto a discharge pipe 12 for a pressure medium. The pressure 15. pipe 11 is connected via a plastics hose or the like to a compressed air source 19 arranged at a distance from the measuring point, via a pressure reducer 18 and a quantity regulator 17. Furthermore there is located in the pressure line a pressure gauge 16 for reading the pressure prevailing 20. in the fluid circuits. Discharge pipe 12 may lead to the open atmosphere in so far as the pressure fluid used is for example compressed air.

The pressure pipe 11 leads directly to the flat front side of the measuring head 3 whilst the discharge pipe 12 25. on this front side has an inlet opening in the form of an annular channel 5.

The capping device 1 consists of a piston 14

receiving the axial thrust 15 of the extensometer rod, which piston is connected via an elastic bellows 13 to a cylinder 10 and projects into this. The cylinder 10 has a head 20 with a central bore 9 which leads freely 5. out at the front side of the cylinder head 20. Between the cylinder head 20 and the measuring head 3 is disposed a diaphragm valve which consists of a diaphragm 8 and a valve body 7. Valve body 7 has a central bore 21 which is aligned with the pressure pipe 11 and two further bores 10. 22 which are in communication with the annular channel 5. The diaphragm 8 is subjected to the hydrostatic pressure prevailing in the cylinder 10 and closes in the usual manner the openings of the bores 21, 22 associated with it. The valve body 7 is tightly connected to the measuring 15. head 3 whilst an outer annular seal 4 and a further seal 6 are disposed between the pressure pipe 11 and the bore 21 associated with it. Furthermore the measuring head 3 together with the diaphragm valve and cylinder 10 and the cylinder head 20 are combined to form one constructional 20. unit.

The diaphragm which as stated closes in the usual manner the outlet openings of bores 21, 22 is raised from said outlet openings when the compensation pressure 16 to be read on the pressure gauge slightly exceeds the 25. pressure in the cylinder 10 so that the pressure medium flowing via the pressure pipe 11 and the bore 21 can flow off via the bores 22, the annular channel 5 and the

discharge pipe 12.

The piston 10 and the bellows 13 may also be replaced by a spring bellows which is protected by suitable means against buckling and on its front side 5. co-operates with the extensometer head.

CLAIMS

1. An extensometer arrangement, for measuring and monitoring movements in rock and soil, has at least two steel rods arranged to be anchored at different positions in the
5. ground, and a measuring system for use in determining relative axial movement of the rod heads, characterised in that the measuring system comprises a respective capping device associated with the head of each steel rod for producing a hydrostatic pressure representative of axial
10. movement of the rod, a measuring device associated with said capping device and in which said hydrostatic pressure is arranged to be compensated by pressure of a fluid fed to said measuring device, and apparatus for measuring the pressure of said fluid.
15. 2. An extensometer arrangement according to claim 1, characterised in that the capping device comprises a piston and cylinder unit connected to the head of the steel rod, and the measuring device has a fluid circuit with a pressure pipe and flow-off pipe parallel thereto, and that between
20. the piston and cylinder unit on the one hand and the outlet of the pressure pipe and the flow-off pipe on the other hand a diaphragm valve is arranged the diaphragm of which is stressed on one side by the pressure of the cylinder whilst with the other side it closes at the same
25. time an outlet of the pressure pipe and an inlet opening of the flow-off pipe.

3. An extensometer arrangement according to claim 2, characterised in that the piston and cylinder unit consists of a piston fixed at the end of the steel rod and a cylinder connected to this via an elastic bellows the head of which
5. cylinder has a bore which connects the cylinder space to one side of the diaphragm.

4. An extensometer arrangement according to claim 2 or 3, characterised in that the pressure pipe and the flow-off
10. another in a measuring head, the pressure pipe leads out directly, the flow-off pipe on the other hand leads into an open annular channel on a front side of the measuring head, and between the front side of the measuring head and the diaphragm a valve disc is arranged which has a bore
15. aligned with the outlet of the pressure pipe and at least two further bores connecting the annular channel to the diaphragm.

5. An extensometer arrangement according to claim 4, characterised in that the pressure pipe leads out into the
20. centre of the annular channel.

6. An extensometer arrangement according to any one of claims 2 to 5, characterised in that the cylinder with its head, the diaphragm valve, the valve disc and the measuring
25. cylinder is connected via the elastic bellows to the piston and the measuring head is connected via plastics pipes to

pressure medium source and the pressure measuring apparatus.

An extensometer arrangement substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

The text of the specification has been reproduced by photocopying the applicants original typescript. It may contain a few amendments which are difficult to read. The original typescript containing these amendments may be inspected on the premises of the Patent Office