

Patent No. 1513385  
Foreign Application  
20 August 1974

Date of Patent..... 1 August 1975  
Date of Sealing..... 22 November 1978



Elizabeth the Second by the Grace of God of the United Kingdom of Great Britain and Northern Ireland and of Her other Realms and Territories, Queen, Head of the Commonwealth, Defender of the Faith: To all to whom these presents shall come greeting:

WHEREAS a request for the grant of a patent has been made by Glotzl, Gesellschaft Fur Baumesstechnik MBH, a German Company, of 11 Forlenweg, D-7512 Rheinstetten 4 (Forchheim), Federal Republic of Germany,

for the sole use and advantage of an invention for A dynamometer for anchors in building constructions:

AND WHEREAS We, being willing to encourage all inventions which may be for the public good, are graciously pleased to condescend to the request:

KNOW YE, THEREFORE, that We, of our especial grace, certain knowledge, and mere motion do by these presents, for Us, our heirs and successors, give and grant unto the person(s) above named and any successor(s), executor(s), administrator(s) and assign(s) (each and any of whom are hereinafter referred to as the patentee) our especial licence, full power, sole privilege, and authority, that the patentee or any agent or licensee of the patentees and no others, may subject to the conditions and provisions prescribed by any statute or order for the time being in force at all times hereafter during the term of years herein mentioned, make, use, exercise and vend the said invention within our United Kingdom of Great Britain and Northern Ireland, and the Isle of Man, and that the patentee shall have and enjoy the whole profit and advantage from time to time accruing by reason of the said invention during the term of sixteen years from the date hereunder written of these presents: AND to the end that the patentee may have and enjoy the sole use and exercise and the full benefit of the said invention, We do by these presents for Us, our heirs and successors, strictly command all our subjects whatsoever within our United Kingdom of Great Britain and Northern Ireland, and the Isle of Man, that they do not at any time during the continuance of the said term either directly or indirectly make use of or put in practice the said invention, nor in anywise imitate the same, without the written consent, licence or agreement of the patentee, on pain of incurring such penalties as may be justly inflicted on such offenders for their contempt of this our Royal Command, and of being answerable to this patentee according to law for damages thereby occasioned:

PROVIDED ALWAYS that these letters patent shall be revocable on any of the grounds from time to time by law prescribed as grounds for revoking letters patent granted by Us, and the same may be revoked and made void accordingly:

PROVIDED ALSO that nothing herein contained shall prevent the granting of licences in such manner and for such considerations as they may by law be granted: AND lastly, We do by these presents for Us, our heirs and successors, grant unto the patentee that these our letters patent shall be construed in the most beneficial sense for the advantage of the patentee.

IN WITNESS whereof We have caused these our letters to be made patent  
as of the first day of August  
one thousand nine hundred and seventy-five and to be sealed.



*Ed Cairns*

Comptroller-General of Patents  
Designs, and Trade Marks.



# PATENT SPECIFICATION

(11)

1 513 385

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- (21) Application No. 32157/75 (22) Filed 1 Aug. 1975 (19)  
 (31) Convention Application No. 2 439 782  
 (32) Filed 20 Aug. 1974 in  
 (33) Fed. Rep. of Germany (DE)  
 (44) Complete Specification published 7 June 1978  
 (51) INT. CL.<sup>2</sup> G01L 1/02  
 (52) Index at acceptance  
 G1W E2A1 E3A1B E7A



## (54) A DYNAMOMETER FOR ANCHORS IN BUILDING CONSTRUCTIONS

(71) I, FRIEDA GLÖTZL, a German Citizen of 11 Forlenweg, D-7512 Rheinstetten 4 (Forchheim), Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

sure increase, and with which advantageously accurate and repeatable measurements can be obtained in so far as displacement of the piston is constrained to take place in a predetermined manner, are not of value for the present purpose on the one hand from the point of view of price and on the other hand due to the sensitivity to breakdown

### SPECIFICATION 1513385

By a direction given under Section 17 (1) of the Patents Act 1949 this application proceeded in the name of GLÖTZL, GESELLSCHAFT FÜR BAUMESSTECHNIK MBH, a German Company, of 11 Forlenweg, D-7512 Rheinstetten 4 (Forchheim), Federal Republic of Germany.

THE PATENT OFFICE

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measuring technology has particular importance in the construction of dams, tunnels, etc.

Besides the stress measuring devices known for a long time from the general measuring technology, it is known to use as dynamometers for this function essentially only displacement measuring apparatus. Thus, for example, there is inserted between the anchor nut and the support a spring and the varying spring length is monitored by a sensor measuring the distance between the spring supports. It is furthermore known to use elastic bodies in place of such springs. The drawback common to both of these known arrangements is that they are very sensitive to temperature fluctuations which in the present field of use must be reckoned with to a considerable extent. The same applies also to bearing fluctuations of the anchor and of the outer attached clamping means. These dynamometers which are preferred compared with stress measuring devices, because of the operating certainty and manufacturing cost, operate therefore with only a moderate accuracy and reproducibility.

Known dynamometers of the kind in which the displacement of a piston in a cylinder is measured as representing a pres-

sure increase, and with which advantageously accurate and repeatable measurements can be obtained in so far as displacement of the piston is constrained to take place in a predetermined manner, are not of value for the present purpose on the one hand from the point of view of price and on the other hand due to the sensitivity to breakdown

Stress and force variations on the anchor lead to variations of the pressure in the pressure chamber. These pressure variations may be measured in conventional manner by means of a pressure gauge, if necessary, with limit sensors for a signalling system or by means of an excess pressure valve which is connected to a pressure

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(71) I, FRIEDA GLÖTZL, a German Citizen of 11 Forlenwag, D-7512 Rheinstetten 4 (Forchheim), Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a dynamometer for anchors in building constructions having a measuring device arranged to be inserted between a fixed support and a fixing nut of the anchor.

In the attachment of anchors to rock structures, and also to concrete structures, the pre-tension force of the anchor is often required to be measured over a long period of time in order, for example, to be able to ascertain in good time any deterioration due to alterations in shape, ground movements, terrain displacements etc. This measuring technology has particular importance in the construction of dams, tunnels, etc.

Besides the stress measuring devices known for a long time from the general measuring technology, it is known to use as dynamometers for this function essentially only displacement measuring apparatus. Thus, for example, there is inserted between the anchor nut and the support a spring and the varying spring length is monitored by a sensor measuring the distance between the spring supports. It is furthermore known to use elastic bodies in place of such springs. The drawback common to both of these known arrangements is that they are very sensitive to temperature fluctuations which in the present field of use must be reckoned with to a considerable extent. The same applies also to bearing fluctuations of the anchor and of the outer attached clamping means. These dynamometers which are preferred compared with stress measuring devices, because of the operating certainty and manufacturing cost, operate therefore with only a moderate accuracy and reproducibility.

Known dynamometers of the kind in which the displacement of a piston in a cylinder is measured as representing a pres-

sure increase, and with which advantageously accurate and repeatable measurements can be obtained in so far as displacement of the piston is constrained to take place in a predetermined manner, are not of value for the present purpose on the one hand from the point of view of price and on the other hand due to the sensitivity to breakdown.

An object of the present invention is to provide a dynamometer, for anchors in building constructions, which on the one hand can have the above mentioned measuring technological advantages of the known dynamometer of the piston and cylinder kind, and which on the other hand may not be sensitive to the temperature fluctuations and position variations which occur in practice.

According to the invention therefore, there is provided a dynamometer, for anchors in building constructions, having a measuring device arranged to be inserted between a fixed support and a fixing nut of the anchor, said measuring device comprising two annular plates arranged for surrounding a head of the anchor which annular plates are connected to one another in a pressure-tight manner at outer and inner peripheries thereof and have rigid body portions between said peripheries at a distance from one another so as to form a pressure chamber containing a pressure fluid, at least one of the two annular plates having portions respectively between the said inner and outer peripheries and the said body portion thereof which are of reduced thickness relative to the said body portion so as to define recesses opening towards the other plate and so as to form flexible zones bounding the whole of the said body portion.

Stress and force variations on the anchor lead to variations of the pressure in the pressure chamber. These pressure variations may be measured in conventional manner by means of a pressure gauge, if necessary, with limit sensors for a signalling system or by means of an excess pressure valve which is connected to a pressure



gauge and which is pressurised with a pump. The measured pressure variation may be for the following reasons proportional directly and reproducibly to the force variation: The area of the bounding faces of the pressure chamber considered cross-wise to the direction of the applied force can be maintained constant due to the rigid construction of the body portions of the annular plates. These rigid body portions are linked to the inner and outer peripheries of the plates via the flexible zones so that a similar kinematic arrangement as with the aforementioned known dynamometer with a piston and cylinder is obtained without however involving disadvantages in respect of sealing since the measuring device is completely closed.

Pressure cushions frequently used in rock construction for stress measurement in stone or concrete would indeed be usable in principle in the present field of use but these pressure cushions have the drawback that the actual effective cross-sectional face is not constant. There are formed under pressure lens-like hollow spaces with, as the case may be, irregular edge limitations so that the actual present reference face is subjected to uncontrollable fluctuations. Also such pressure cushions can be produced only with difficulty in the annular shape necessary with anchors and then the said surface fluctuations are still greater.

According to a preferred embodiment of the present invention the flexible zones are formed by internal annular grooves in the or each said plate. The two plates can thus be produced as simple turned parts so that the whole apparatus can be made with far less expenditure compared with conventional apparatus.

In a further construction of the preferred embodiment it is provided that adjacent to each internal annular groove in the or each said plate there is arranged a respective external annular groove which defines a respective further portion of reduced thickness relative to the body portion of the respective plate.

With this embodiment the arrangement may be such that the flexible zones consist of the first said reduced thickness portions of the annular plates, thin walls between the adjacent grooves and the said further reduced thickness portions, whilst the annular plates over their greatest area as well as at flanges at the outer peripheries thereof are rigid. Thus it can be ensured that the inner faces of the body portions always maintain a constant relative disposition. The flexible zones have the form of a thin walled 'Z'-profile whereby a kind of joint is provided around which the thick rigid body portion can lift.

Although the aforementioned construc-

tional features need only be realised on one plate, advantageously both annular plates are formed identically. This brings about from the manufacturing technical point of view the advantage that for each apparatus only two equal parts have to be manufactured and upon connecting the two plates no irregular displacement occurs. From the mounting technological point of view it is of advantage for the built-in position of the measuring device to be a matter of indifference so that its function need not be adversely influenced by a faulty construction.

A measuring line leading to the measuring device may be placed suitably on flanges at the outer peripheries of the plates so as to extend parallel to and in alignment with the space between the said body portions.

The invention will now be described further by way of example only and with reference to the accompanying drawings in which:—

Fig. 1 is an axial section through the head of an anchor fitted with the measuring device of one form of a dynamometer according to the invention; and

Figs. 2 to 4 are diagrammatical illustrations of different embodiments of pressure gauges for use with the arrangement of Fig. 1.

Fig. 1 shows the head of an anchor 1 which, for example, is inserted in rock, concrete 2 or the like. The anchor may be of any known construction and a detailed description of the anchor is therefore not necessary. The anchor 1 is pre-tensioned by means of a nut 3 which is supported via a load-distributing plate 4, a measuring device or transducer 5 and a support plate 6 on the sub-soil 2. The measuring device 5 consists of two annular plates 7, 8 which surround concentrically the anchor 1 and in the embodiment shown are formed in the same manner. The annular plates 7, 8 have thick rigid body portions 9, 10 between the inner and outer peripheries of the plates which are disposed at a short distance from one another so that a pressure chamber 11 is formed between them. This pressure chamber 11 between the two rigid body portions 9, 10 is closed by two likewise rigid edge flanges 12, 13 and 14, 15 on the inner and outer peripheries of the two annular plates 7, 8.

Between the outer and inner peripheries and the body portions 9, 10, the two plates 7, 8 are weakened by internal annular grooves 16, 17 and 18, 19 such that flexible zones 20, 21 and 22 and 23 result. These zones are formed by the reduced thickness portions of the plates at the bottoms of the grooves, and by the thin peripheral walls 24, 25 and 26, 27 remaining at the sides of the grooves. The flexible zones are in the embodiment shown, extended by further



reduced thickness portions 28, 29 and 30, 31 of the plates 7, 8 connected to the peripheral walls 24 to 27 which further portions are the bottom walls of external annular grooves 32, 33 and 34, 35. These further portions merge with the thick flanges 12, 13 and 14, 15. Both annular plates 7, 8 may be made as simple turned parts. The connecting of the annular plates may be effected by welding, soldering or the like.

At any desired place on the measuring device, the measuring line 36 is fixed, for example, by soldering. The two flanges 12, 13 are at this place provided with a small cross bore. This measuring line may as shown in Figs. 2 and 3 be appropriately bent and connected in an appropriate manner to an appropriately positioned fixed pressure gauge 37 or 38 and the pressure gauge 38 may be provided with two limit devices 39, 40 for example, corresponding to maximum and minimum values, which are arranged to actuate a signalling system when the force on the anchor exceeds or falls below a pre-determined pretension force. In Fig. 4 an embodiment is shown in which the measuring line 36 leads to an excess pressure valve 42 which is pressurised with a pump and which is connected, as shown in the drawing, to a pressure gauge.

#### WHAT I CLAIM IS:—

1. A dynamometer, for anchors in building constructions, having a measuring device arranged to be inserted between a fixed support and a fixing nut of the anchor, said measuring device comprising two annular plates arranged for surrounding a head of the anchor which annular plates are connected to one another in a pressure-tight manner at outer and inner peripheries thereof and have rigid body portions between said peripheries at a distance from

one another so as to form a pressure chamber containing a pressure fluid, at least one of the two annular plates having portions respectively between the said inner and outer peripheries and the said body portion thereof which are of reduced thickness relative to the said body portion so as to define recesses opening towards the other plate and so as to form flexible zones bounding the whole of the said body portion.

2. A dynamometer according to claim 1, wherein the said portions of reduced thickness formed by internal annular grooves in the or each said plate.

3. A dynamometer according to claim 2, wherein adjacent to each internal annular groove in the or each said plate there is arranged a respective external annular groove which defines a respective further portion of reduced thickness relative to the body portion of the respective plate.

4. A dynamometer according to any one of claims 1 to 3, wherein both annular plates are identical.

5. A dynamometer according to any one of claims 1 to 4, wherein both annular plates are formed as turned parts.

6. A dynamometer according to any one of claims 1 to 5, wherein a measuring line is fixed on flanges at the outer peripheries of the plates and extends parallel to and in alignment with the space between the said body portions.

7. A dynamometer substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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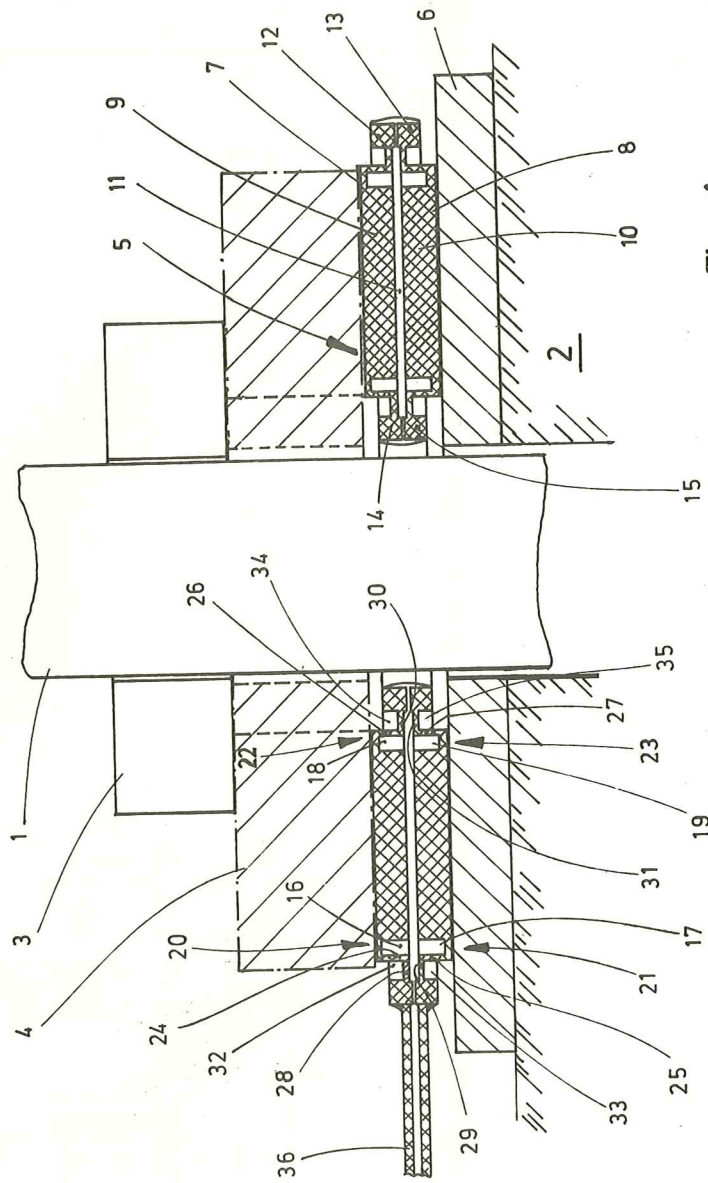


Fig. 1

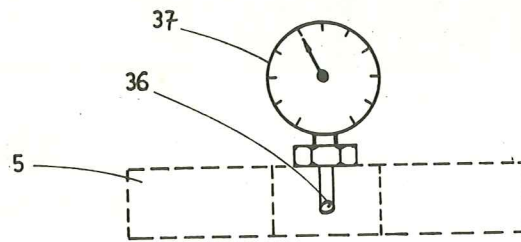


Fig. 2

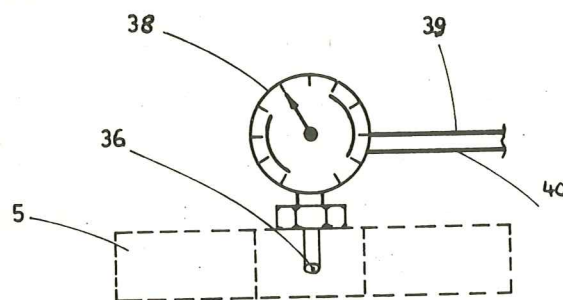


Fig. 3

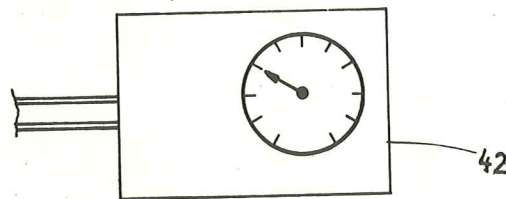
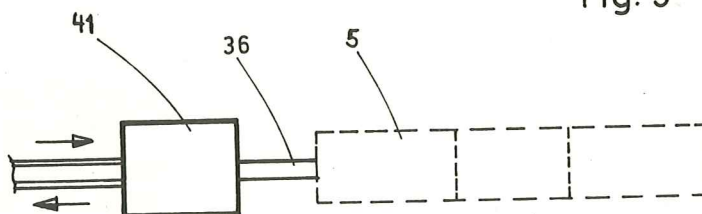


Fig. 4



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IN WITNESS whereof We have caused these our letters to be made patent  
as of the first day of August  
one thousand nine hundred and seventy-five and to be sealed.



*ern* *Caris*

Comptroller-General of Patents  
Designs, and Trade Marks.



SUBJECT TO THE PROVISIONS  
OF THE PATENTS ACT 1947  
AND THE PATENTS RULES 1973.

NOTE

You are reminded that this patent is granted for a term beginning on the date of the filing on the complete specification (that is the date of the patent given overleaf) and ending at the expiration of 16 years from that date, subject to the payment by you or by someone on your behalf, before the expiration of the 4th and each succeeding year during the term of the patent, of the prescribed fees. All or any of these annual payments may be made in advance and a Patents Form 24 should accompany the appropriate fees.

You are warned that if the form with the fee is not lodged in the Patent Office on or before the anniversary date of the patent, the fee cannot be accepted unless application for an extension of time to a maximum of 6 months is made and paid for on Patents Form 25. Thereafter if no renewal fee is received and no extension of time is requested, the patent will cease.

No reduction of extension fees is made in the case of a patent endorsed "Licences of Right". When paying a renewal or extension fee you are advised to check the current scale of charges as these may change from time to time.

If any person becomes entitled by assignment, transmission or other operation of law to this patent, or a part interest therein, or to any interest as mortgagee or licensee or otherwise, application must be made to the Comptroller to register such title of interest (see Section 74 of the Patents Act). Particulars as to the manner of making such application may be obtained from the Patent Office.

PROCEDURE FOR PAYMENT OF FEES

Patents fees are payable direct to the Patent Office by means of cash, money order, postal order, banker's draft or cheque. (Adhesive stamps will not be accepted in payment of fees.) The prescribed fee must be submitted together with the appropriate completed Patents Form; in addition each form or batch of forms should be accompanied by a fee sheet (FS. 1) showing details of the form(s) and the amount(s) of the fee(s). Cheques, money orders, etc., should be made payable to "The Comptroller-General, Patent Office", and crossed. Patents Forms, together with the fees and fee sheet (FS. 1) may be delivered to the Patent Office in London either by hand or by post; those sent by post should be addressed to "The Cashier, The Patent Office, 25 Southampton Buildings, London WC2A 1AY".

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