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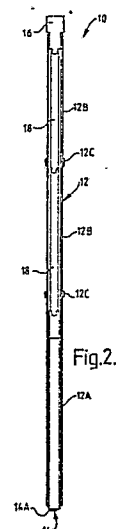
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54 Improvements in or relating to soil sampling.

57 Soil sampling equipment (10) comprises an inner sampling tube (14) and extension rods (18), and outer sacrificial tube (12) having a ground piercing tube (12A) and extension pieces (12B). The inner and outer tubes are a relatively close clearance fit and are driven into the ground simultaneously by any suitable means, e.g. a weight dropped repeatedly from a given height.



Description

IMPROVEMENTS IN OR RELATING TO SOIL SAMPLING

This invention relates to the taking of soil samples so as to determine the nature and properties of the soil for the purposes of building and construction works on land.

In particular, the invention relates to a method and apparatus for extracting soil samples.

An apparatus and method at present used, comprises driving into the ground, an outer tube which includes a number of secured together extensions until the required depth is reached. An inner sampling tube which also includes a number of secured together extensions is then driven into the ground within the outer tube until the required depth, or depths is or are reached. At any required depth a soil sample can be extracted. Also at any required depth a standard penetration test can be performed.

There is a relatively large clearance between the inner sampling tube and the outer tube and the outer tube is removed after the required samples have been extracted and tests performed. In this arrangement and method the relatively large clearance is provided to allow for any deviation of the sampling tube due to obstructions, e.g. rocks, at the sampling site. The outer tube cannot be left in the ground on account of its value and has to be extracted. The removal of the outer tube can sometimes be difficult, complex and time consuming. Also relatively heavy and cumbersome driving equipment is required to force the outer tube into the ground.

This present method and apparatus is therefore relatively complex and cumbersome to use and is time consuming as far as setting up and removal is concerned. This present method and apparatus whilst adequate for large-scale construction works is not sufficiently adaptable to cope with site investigations of a smaller scale.

It is known from Patent Specification GB1268629 to provide in the obtaining of underwater cores, a heavy section outer coring casing and a lighter inner coring casing. The outer casing is positioned by rotary and percussive loading whilst the inner casing is positioned by rotary action with a constant bearing pressure. When the inner and outer casings are in position coring rods are inserted by rotary action. The inner coring casing provides protection for the coring rods whilst the outer coring casing provides protection for the inner coring casing.

Relatively large clearances between the inner and outer coring casings and the coring rod and the inner casings are disclosed. Also it is to be expected that once core samples have been extracted both the inner and outer coring casings will be removed.

Patent Specification GB318887 discloses a pile tube having inner and outer cores. The pile tube is driven into the subsoil and chemicals or freezing materials are injected into the sample so that the sample is retained when the inner core is removed. Again there is a relatively large clearance between the inner and outer cores and it is to be presumed that the outer tube is removed after sampling has

taken place.

Patent Specification GB311286 discloses a pile tube similar to that disclosed in GB318887 except that there is a mechanical sample retaining mechanism at the lower end of the inner core tube to retain the sample within the inner core tube. It is disclosed that the outer core tube of the pile tube can be withdrawn or it can be left in the sub-soil to act as a supporting pile.

In the case of the present invention whilst the outer tube or a majority of it can be left in the ground that outer tube is of insufficient size to act as a supporting pile.

Patent Specification US3696873 discloses a soil sampling device comprising an outer driver sleeve and an inner sample tube. A driver cap is attached to the driver sleeve and both the driver sleeve and sample tube are driven into the ground by a driver head. Once a sample or samples have been taken by withdrawal of the sample tube leaving the driver sleeve in the ground, the driver sleeve itself is removed using handles which are attached to the driver sleeve.

In contrast, as has been emphasised in the case of the present invention the outer tube or a majority of it is left in the ground after soil samples have been taken.

Therefore the present invention seeks to provide an apparatus and method for soil sampling and testing, in which the apparatus is relatively lightweight and requires less cumbersome equipment for driving the outer tube and inner sampling tube into the ground.

In particular the present invention provides that the inner and outer tubes are a relatively close fit, and the outer tube or a majority of it can be left in the ground after the samples and tests have been completed. In some circumstances it may be possible to extract the uppermost piece of the outer tube.

Accordingly the present invention provides soil sampling equipment comprising a re-usable inner sampling tube including a ground piercing end and a plurality of extension pieces, and an outer sacrificial tube including a ground piercing end and a plurality of extension pieces, together with a driving head engageable with the ends of the inner and outer tubes remote from the ground piercing ends.

The inner and outer tubes are preferably a close clearance fit and the driving head which can be secured to the inner tube, is contactable with the uppermost extension piece of the outer tube.

Any suitable driving means for contacting the driving head to drive the inner and outer tubes into the ground can be used for example, a percussively driven weight or a pneumatic or hydraulic jack.

The present invention further provides a method of sampling soil including the steps of assembling a driving head and a sampling tube together with a first length of an outer tube, forcing the assembled inner and outer tubes into the ground to a pre-determined

depth, withdrawing the sampling tube and extracting the sample, adding an extension piece to both the inner and outer tubes, forcing the inner and outer tubes into the ground to a further pre-determined depth, withdrawing the sampling tube and extracting the sample, adding further extensions to both tubes and extracting samples until the required final depth is reached, withdrawing the sampling tube from the said final depth and leaving the outer tube in situ.

The method can include withdrawing the uppermost extension piece of the outer tube whilst leaving the remaining part of the outer tube in situ.

The method further envisages after any one of said soil samples has been extracted, adding an extension piece to the sampling tube only and forcing the sampling tube into the ground to perform a standard penetration test, withdrawing the sample tube and extracting the sample.

The present invention will now be more particularly described with reference to the accompanying drawings in which

Fig. 1 shows a section through the ground piercing ends of the inner and outer tubes of one form of soil sampling equipment according to the present invention,

Fig. 2 shows the driving ends of the inner and outer tubes of Fig. 1 together with extension pieces,

Fig. 3 shows a typical extension piece for the outer tube and

Figs. 4 to 7 inclusive illustrate sequentially the methods of using the soil equipment illustrated in Figs. 1 to 3.

Referring to the drawings, soil sampling equipment 10 comprises an outer tube 12 and an inner sampling tube 14 together with a drive cap 16.

The outer tube 12 comprises a ground piercing end 12A and a number of extension pieces 12B whilst the sampling tube 14 comprises a ground piercing end 14A, a split tube 14B and a connecting piece 14C, the sampling tube being attachable to a number of extension rods 18.

The extension tubes 12B are not secured to one another or to the ground piercing end 12A but abut one another and are located by means of a collar 12C.

The end 14A is screwed to the split tube 14B which itself is screwed to the connecting piece 14C. The drive cap 16 is attached to the connecting piece 14C and has a shoulder 16A which abuts the uppermost end of the ground piercing end 12A or one of the extension tubes 12B.

Fig. 1 shows the first stage of assembling soil equipment according to the present invention in which the sampling tube end 14A is attached to the drive cap 16 by means of the connecting piece 14C and is then passed through the outer tube and 12A until the shoulder 16A abuts the uppermost end of the outer tube end 12A.

Fig. 2 shows the ends 12A and 14A with their respective extension tubes 12B and extension rods 18 located in position.

Referring to Figs. 4 to 7, in Fig. 4 the ends 12A, sampling tube 14 and drive cap 16 are assembled as illustrated in Fig. 1. The ends 12A and 14A of the sampling and outer tubes are then forced into the

ground simultaneously by the application of a load in the direction of arrow "A" by any suitable means. For example the load can be a mechanically driven hammer, a weight dropped under control from some pre-set height onto the drive cap or an hydraulic or pneumatic jack.

When the ends 12A and 14A have been driven to the required depth the sampling tube 14 is removed by lifting the drive cap 16 and the sample from the interior of the sampling tube 14B is extracting for analysis and test. An extension tube 12B is located on the end 12A and an extension rod 18 is added to the sampling tube and 14A (Fig. 5).

A load is once again applied to the driving cap 16 to force the ends 12A and 14A together with the extension tubes 12B and extension rods 18 into the ground until the further required depth is reached as shown in Fig. 6. The extraction of the sample for analysis and tests and the addition of extension rods and tubes as illustrated in Fig. 5 is repeated until the final required depth is reached.

Alternatively as shown in Fig. 7, after the sample has been extracted an extension 18 is attached to the sampling tube only and a standard penetration test (SPT) can then be performed. The taking of samples can then continue by the addition of an outer extension tube as illustrated with reference to Figs. 5 and 6. The standard penetration test can be performed at any desired depth within the range of operation of the soil sampling equipment.

The sampling tube 14 can be of any standard type such as a split spoon sampler as shown in Fig. 1 or a thin walled sampler.

The present invention enables standard sampling tubes and extension rods to be used in conjunction with a relatively inexpensive sacrificial outer tube and extension pieces having an internal diameter so that the sampling tube is a relatively close clearance fit within it.

For example the outer casing can be $2\frac{1}{2}$ inches outside diameter with a wall thickness of 2mm and the sampling tube can be 2" outside diameter. In such an arrangement the clearance between the inner and outer tubes will be approximately 4mm.

Such an arrangement enables the equipment to be relatively more portable than the existing equipment, requiring less cumbersome and heavy machinery to force the outer and inner tubes into the ground, to be more adaptable and to be less time consuming in setting up, operating and dismantling.

As well as sampling tubes of the split spoon or thin walled types the sampling tubes known as reducing slot tube samplers can also be used.

Reducing slot tube samplers comprise steel tubes of various diameters in which the tubes are provided with longitudinally extending opposed slots at various locations along the length of the tube so that a sample contained within the tube can be viewed.

Reducing slot tube samplers are particularly useful for taking samples in heavy clay soils.

In order to use reducing slot tube samplers in accordance with the present invention the inner sampling tube 14 as described above is substituted with a slot tube sampler which can be a tube made up of single length or a series of lengths in which the

slot tube sampler is of a diameter such that it is a relatively close fit with the outer tube 12. The inner and outer tubes are forced into the ground as described above with reference to figures 4 - 6 inclusive and Fig. 7 and the slot tube sampler is withdrawn at the required depths for samples to be extracted. Split tube samplers of successively smaller diameters can then be driven into the ground and these slot tube samplers will be supported not only by the outer tube 12 which remains in the soil but by the soil left internally of the sampling tube 12 after successive samples have been taken using slot tube samplers of reducing diameters.

The absence of a relatively large clearance to allow for deviation of the sampling tube is unlikely to be detrimental in the operating range up to 6m, of the apparatus according to the invention. The extraction of soil samples and the performance of standard penetration tests can be performed at less expense and less time than the presently known equipment described above. The equipment will also be relatively lighter in that the outer tube and extension tubes are much lighter than the existing outer tubes.

Claims

1. Soil sampling equipment comprising a reusable inner sampling tube having a ground piercing end and a plurality of extension pieces, an outer sacrificial tube having a ground piercing end and a plurality of sacrificial extension pieces, and a driving head engageable with the ends of the inner and outer tubes or their respective extension pieces, remote from their ground piercing ends.

2. Equipment as claimed in claim 1 in which there is a relatively close clearance fit between the inner and outer tubes.

3. Equipment as claimed in claim 1 or claim 2 in which the driving head is securable to the inner tube or an extension piece thereof and is contactable with the outer tube or an extension piece thereof.

4. Equipment as claimed in any one of the preceding claims including driving means to force the inner and outer tubes and their respective extension pieces into the ground.

5. Equipment as claimed in claim 4 in which the driving means comprise an hydraulic or pneumatic jack.

6. Equipment as claimed in claim 4 in which the driving means comprises a percussively driven weight.

7. Equipment as claimed in any one of the preceding claims in which the sampling tube comprises a split spoon sampler or a thin walled sampler.

8. Equipment as claimed in any one of the preceding claims 1 to 6 in which the sampling tube comprises a slot tube sampler.

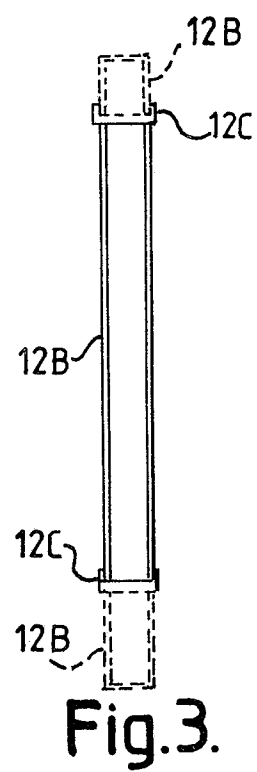
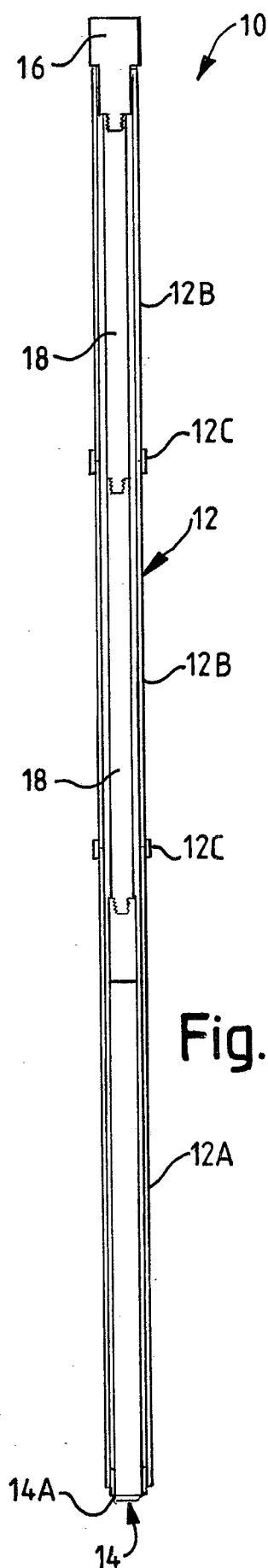
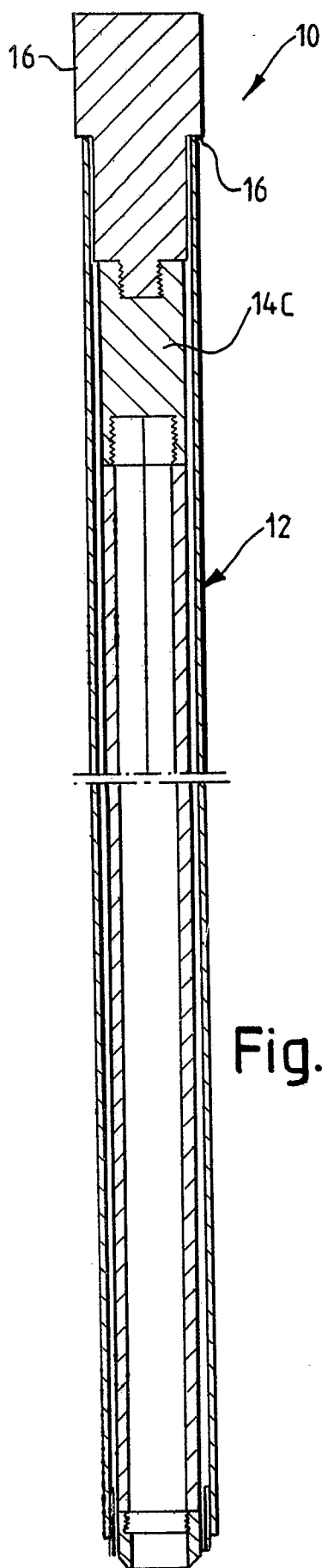
9. A method of sampling soil using the soil sampling equipment as claimed in any one of the preceding claims, including the steps of assembling a driving head and a sampling tube together with a

first length of outer tube, forcing the assembled inner and outer tubes into the ground to a predetermined depth, withdrawing the sampling tube and extracting the sample adding respective extension pieces to both the inner and outer tubes, forcing the inner and outer tubes into the ground to a further pre-determined depth, withdrawing the sampling tube and extracting the sample, adding further extensions to both tubes until the final required depth is reached, withdrawing the sampling tube from the said final depth and leaving the outer tube and extension pieces in situ.

10. A method as claimed in claim 9 including the step of withdrawing the uppermost extension piece of the outer tube whilst leaving the remaining extension pieces in situ.

11. A method as claimed in claim 9 or claim 10 including the steps of adding an extension piece to the sampling tube only after a soil sample has been extracted and forcing the sampling tube into the ground to perform a Standard Penetration Test, withdrawing the sampling tube and extracting the sample, and adding an extension piece to the outer tube.

12. A method of sampling soil as claimed in claim 9 in which the sampling tube comprises a slot tube sampler in which slot sampling tubes of reducing diameters are successively driven into the soil to take samples of successively smaller diameters.



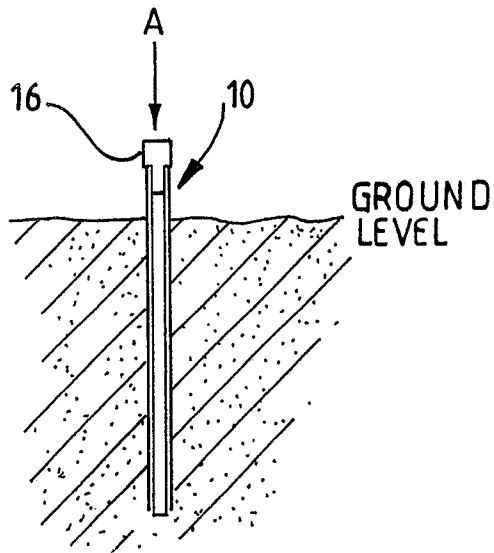


Fig. 4.

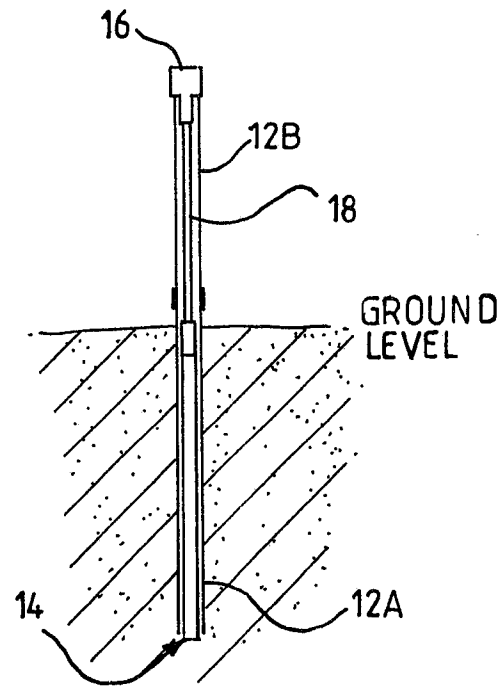


Fig. 5.

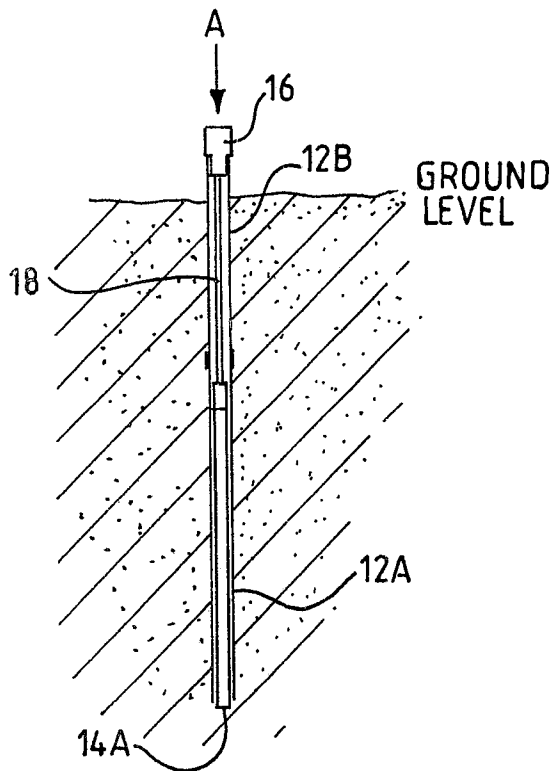


Fig. 6.

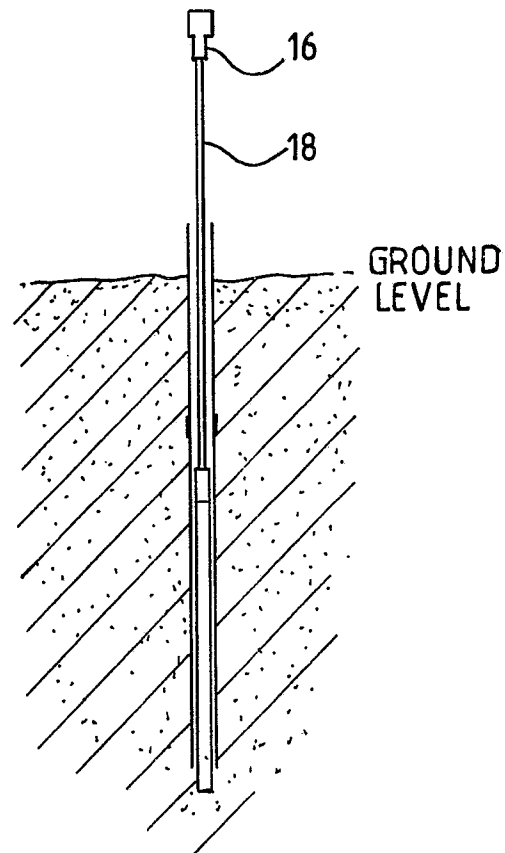


Fig. 7.



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 30 7873

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X,D	US-A-3 696 873 (ANDERSON) * Column 1, line 58 - column 2, line 2 *	1-4,7,9 ,10	E 21 B 25/04 E 21 B 7/20 E 21 B 7/26 E 21 B 49/00
Y	---	5,6,8, 11,12	
Y	CH-A- 331 148 (SIMON) * Page 1, lines 48-57 *	11	
Y	---		
Y	GB-A-1 094 438 (WESTINGHOUSE ELECTRIC CORP.) * Claim 1 *	5	
Y	---		
Y	US-A-3 842 916 (WATANABE) * Abstract *	6	
Y	---		
Y	US-A-4 482 021 (REPSKI) * Column 5, lines 17-24 *	8	
Y,D	---		
Y,D	GB-A-1 268 629 (ROCK FALL CO., LTD) * Page 2, lines 124-125 *	12	
X	---		
X	DE-C- 645 448 (BAUER) * Whole document *	1-4,9, 10	TECHNICAL FIELDS SEARCHED (Int. Cl.4) E 21 B
A,D	---		
A,D	GB-A- 311 286 (VEREINIGTE STAHLWERKE AG) * Whole document *	1	
A,D	---		
A,D	GB-A- 318 887 (VEREINIGTE STAHLWERKE AG) * Whole document *	1	
A	---		
A	US-A-2 283 650 (SANBORN) * Whole document *	1	

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		30-11-1988	SOGNO M.G.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-1 733 312 (NISHIO) * Whole document * -----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30-11-1988	Examiner SOGNO M.G.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			