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(54) **Piling.**

(57) Continuous flight auger piling is performed using an auger having a hollow stem 1 and a continuous flight 2. The auger is screwed into the ground and is then extracted whilst concrete is pumped down the stem 1. Extracting the auger lifts the spoil out of the ground and a concrete pile is formed. In order to monitor the flow of concrete and prevent voids forming electrical conductivity sensors 5 are provided. If a void forms, the conductivity drops sharply and the driver can reduce the rate of extraction or stop extraction until the conductivity has regained its proper level.

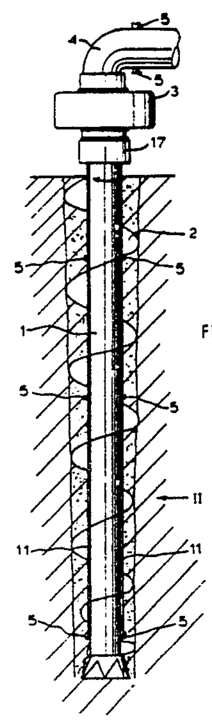

FIG. 1

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Piling

Background of The Invention

The present invention relates generally to a method of piling comprising inserting or screwing an auger into the ground until the required depth is reached, to form a bore and extracting the auger and passing a settable pile-forming material into the ground as the auger is extracted using a duct associated with the auger and which is extracted as the auger is extracted, in order to form a pile. As the auger is extracted, it lifts spoil out of the bore. Normally, the settable material will be concrete or grout and normally the duct will be a hollow stem of the auger itself. Normally the auger will have a substantially continuous flight.

One cannot rely upon the volume of concrete required corresponding to the volume of the flow. If the soil is poor, concrete flows out laterally into the soil and considerably more concrete is required. The amount of concrete required per unit time depends primarily upon the rate of extraction of the auger which determins the rate of formation of the void to be occupied by the concrete. The rate of extraction must not be so fast that a larger void is being formed than can be filled by the inflowing concrete. However too slow a rate is uneconomic, wastes concrete and can cause practical difficulties in extracting the auger. The correct extraction rate is therefore important for the satisfactory formation of the pile, and it is desirable to find a method in which there is reasonable certainty of the correct withdrawal rate being used.

The Invention

The present invention provides methods as set forth in Claims 1, 2 or 3 and an auger as set forth in Claim 8. The remaining Claims set forth preferred features of the invention.

By sensing the conductivity (or other property) of the contents of the duct or stem, one can determine the level of the concrete (or other settable material) during extraction. If the level is above the conductivity sensor or probe, a higher conductivity will be sensed. Provided the level is kept above a certain critical level at all times, the pile will be satisfactorily formed. Although essentially very simple, this invention can lead to improved formation of piles and reduced wastage of concrete.

Although more sophisticated methods of sensing may in theory be possible, it is found that simple conductivity sensing provides an arrangement which can resist the very aggressive environment in which the auger will be working - the ground can contain bricks or gravel or pieces of rock, etc., and the inside of the stem is subject to abrasion from the pumped settable material.

Preferred Embodiment

The invention will be further described, by way of example, in which:

Figure 1 is a schematic view, showing a continous flight auger of the invention, being screwed into the ground;

Figure 2 is a detail looking in the direction of the arrow II in Figure 1;

Figure 3 is a section along the line III-III in Figure 2;

Figure 4 is an axial section. on an enlarged scale compared to Figure 1, of the head of the auger; and

Figure 5 is a section along the line IV-IV in Figure 4.

The auger has a hollow stem 1, a continous flight 2, a rotary drive head 3, and a steel swivel assembly 4 for connection to a concrete pump (not shown).

The auger has a number of conductivity monitors or sensors 5. There are typically two diametrically-opposed monitors 5 adjacent the bottom of the auger, i.e. adjacent to the point of injection, and there are other monitors higher up. The positioning of the monitors 5 depends upon the length of the auger and ground conditions (for instance wet sand and gravel well below the water table may require a much higher head of concrete than stiff clay); in general, it is desireable to have concrete about half way up the auger. There should be monitors 5 located at this level; additional monitors 5 near the top and bottom of the auger have been found useful.

Figures 2 and 3 show one monitor 5. The monitor 5 is operative on the inside of the stem 1 and is in the form of a screwed insert 6 carrying a steel probe 7 with a suitable insulating sleeve 8. There is a protective housing 9 with a screw cap 10.

A pipe 11 (such as a gas barrel) is strongly welded to the auger stem 1 and has suitable Tee-pieces 12 having short branch pipes 13 which penetrate the respective housings 9, enabling leads 14 to be taken to the probes 7. The housings 9 can be protected by welded-on strapping 15.

The leads 14 have to be taken out in a suitable manner since the auger stem is continuously rotating during drilling and construction of the pile. Figure 4 shows that slip rings 16 can be used with sliding contacts carried on a stationary annular housing 17 suspended below the drive head 3 with a suitable gland packing or water-proofing 18. Further pairs of slip rings can be added for each pair of monitors 5.

Figure 1 shows a single auger of for instance 6 m or 8 m length, but a string of augers can be made up for piling to greater depths. Joints can be formed between lengths of auger by providing suitable joints for the pipes 11 and connectors for the leads 14.

In the present assembly, an electric current is passed between the head of one probe 7 and the diametrically-opposed probe 7 and the electrical conductivity is monitored between the probes 7. If the concrete becomes depleted, air (normally under reduced pressure) will be present and the conductivity will fall sharply. The current flowing can be indicated on ammeters 19 for the various pairs of probes 7.

Monitoring the conductivity at different levels enables information to be provided to the operator, so that he can control the extraction more precisely. As shown in Figures 1 and 4, monitors 5 can be provided on the swivel assembly 4, or they can even be provided closer to the concrete pump. Particularly if the concrete pump is the conventional piston pump the monitors 5 above the drive head 3 can detect surges or pulses in the concrete; as it is known what volume of concrete is pumped by each stroke or cycle of the pump, this detection can give a good indication of the rate of flow. This mechanism appears to be a change in conductivity when there is a pressure stroke from the pump which is clearly distinguishable from both the 'pause' stroke of the pump and the case when there is air only between the monitors 5.

It is not essential that the conductivity should be measured between opposed, localised monitors. For instance, one probe 7 could be used with the auger stem 1 itself acting as the other pole (at earth potential).

The present invention has been described above purely by way of example, and modifications can be made within the spirit of the invention. Pressure sensors, or other means of measuring physical properties that indicates the presence or absence of concrete or grout, could be used in place of the electrical conductivity sensors.

Claims

1. A method of piling, comprising inserting an auger (1,2) into the ground to form a bore, extracting the auger (1,2), and passing a settable pile-forming material into the ground as the auger (1,2) is extracted using a duct (1,4) associated with the auger (1,2) and which is extracted as the auger (1,2) is extracted, in order to form a pile, characterised in that a property of the contents of the duct (1,4) is sensed and the rate of extraction of the duct (1,4) is reduced or extraction is stopped if the property alters substantially.

2. A method of piling, comprising forming a bore with an auger (1,2) which has a hollow stem (1), passing settable pile-forming material down the interior of the stem (1) into the bottom of the bore and extracting the auger (1,2), characterised in that during extraction the level of concrete inside the stem (1) of the auger (1,2) is monitored using means (5) for sensing a property of the concrete, and the rate of extraction is reduced or extraction is stopped if no settable material is sensed, until settable material is again sensed.

3. A method of piling comprising inserting an auger (1,2) into the ground to form a bore, extracting the auger (1,2) and passing a settable pile-forming material through a duct (1,4) into the ground as the auger (1,2) is extracted, in order to form a pile, characterised in that the electrical conductivity or another property of the contents of the duct (1,4) is sensed in order to determine the rate of flow of the settable material along the duct (1,4).

4. The method of Claim 1, wherein said property is the electrical conductivity, the rate of extraction of the duct (1,4) being reduced or extraction stopped if the conductivity drops substantially.

5. The method of Claim 2 or 3, wherein said property is the electrical conductivity.

6. The method of Claim 4 or 5, wherein the electrical conductivity is sensed between sensors (5) at the same level in the duct (1,4).

7. The method of Claim 4 or 5, wherein the electrical conductivity is sensed between sensors (5) at different levels in the duct (1,4).

8. An auger (1,2) having a hollow stem (1), for piling by inserting the auger (1,2) into the ground and extracting the auger (1,2) while passing settable pile-forming material down the auger (1) into the ground to form a pile, characterised in that there is at least one sensor (5) inside the stem (1) for sensing a property of the contents of the stem (1), to thereby enable the level of settable pile-forming material inside the stem (1) to be monitored and the rate of extraction of the auger (1,2) to be controlled.

9. The auger of Claim 8, wherein the sensor (5) is in the form of an electrically-conductive element (7) on the inside of the stem wall carried on an insert (6) fixed to the stem wall and insulated from the element (7), the exterior of the element (7) projecting radially outwards of the stem wall and being protected by a housing (9,10).

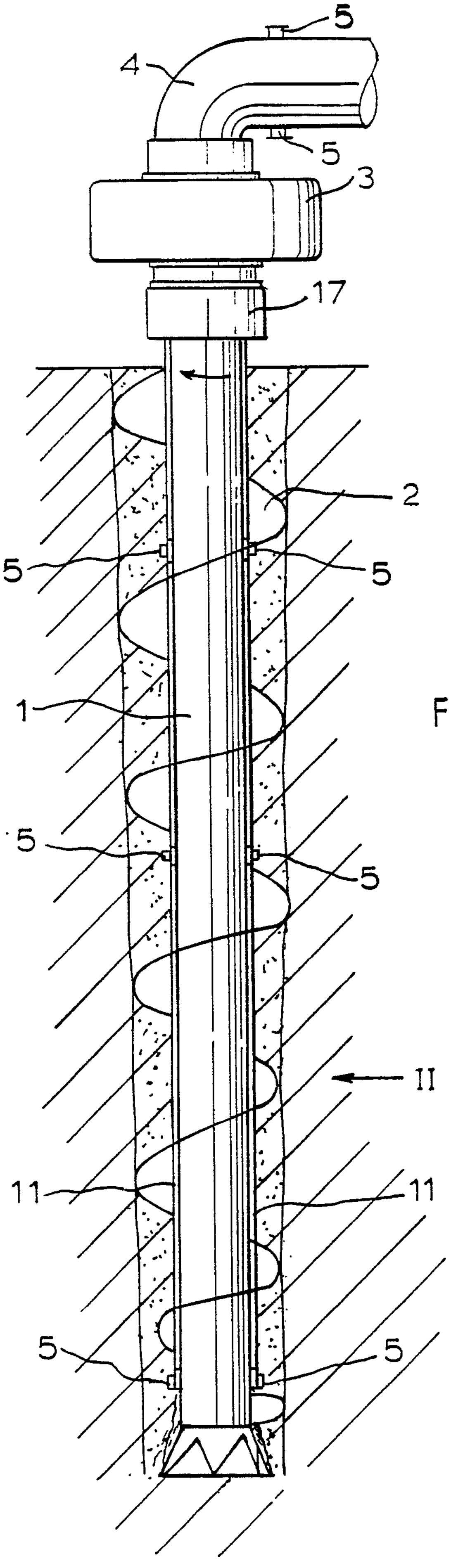

FIG. 1.

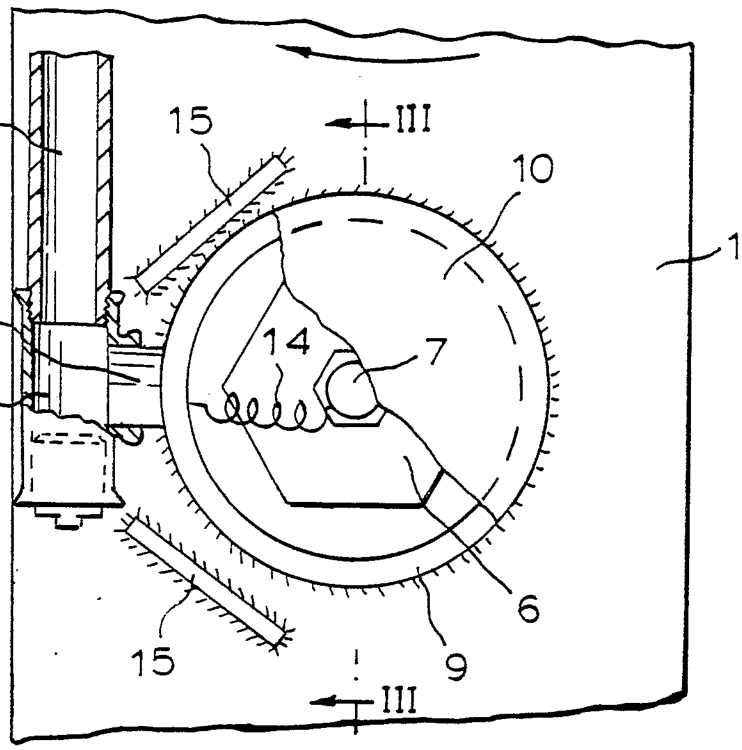

FIG.2.

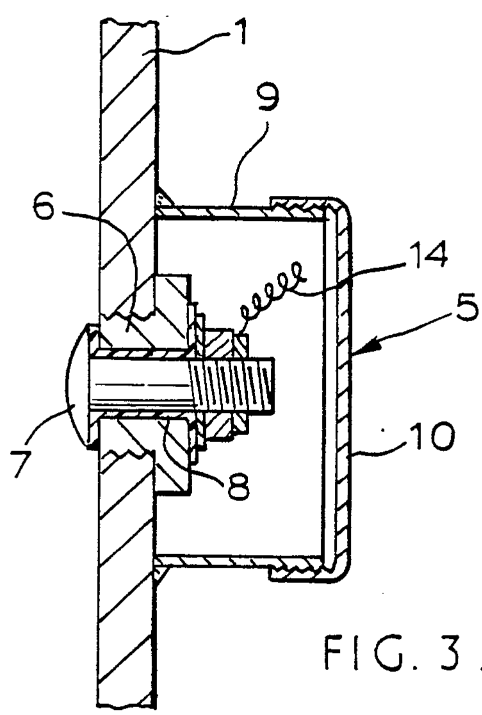

FIG. 3.

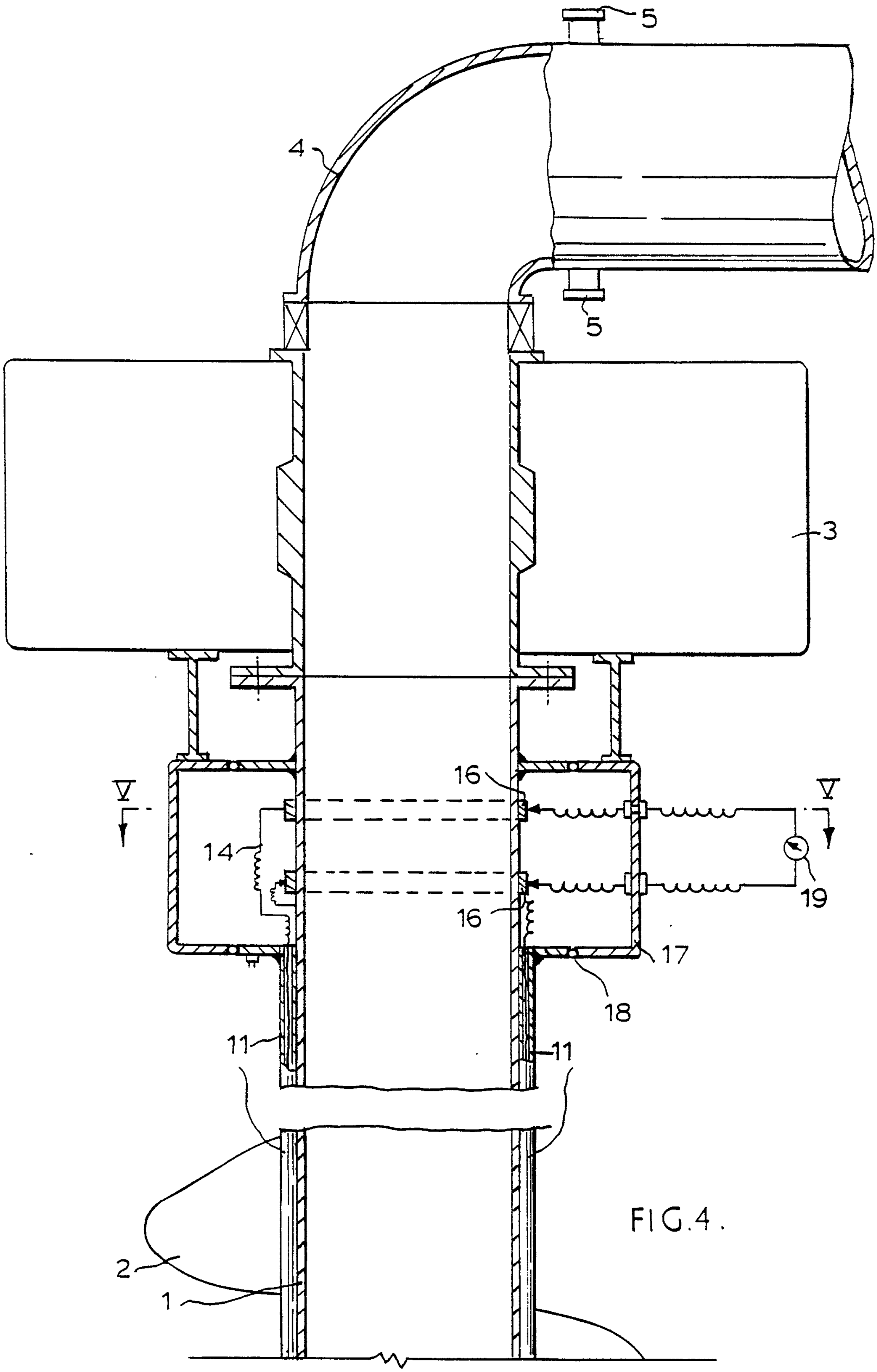

FIG.4.

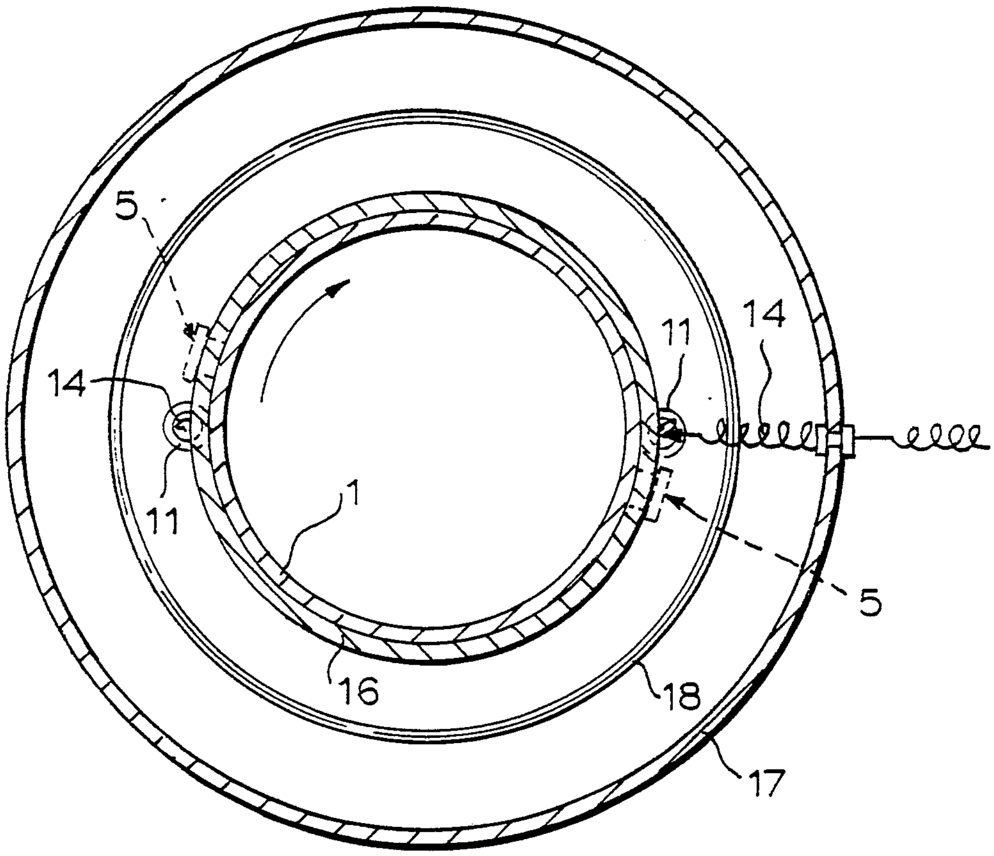

FIG.5.