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(54) Heating of bearing and the like.

(57) An induction heater for ring-like articles such as bearings includes a hinged clamp-like magnetically inductive core of ferrite which can be opened to receive and closed to accommodate the article to be heated and which has a primary winding and a source of high frequency current derived from a switch mode power supply; and having temperature sensors and safety circuits adapted to prevent damage due to too high temperatures and to ensure proper operation for articles of differing sizes.

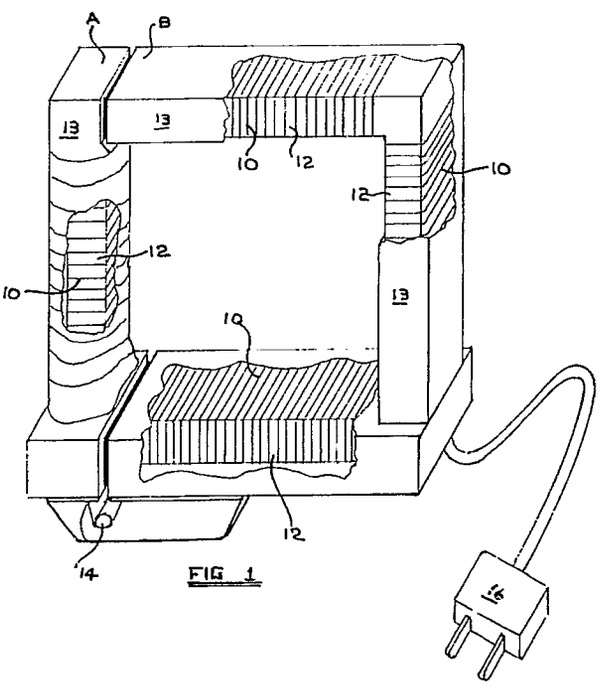

FIG 1

EP 0 434 204 A1

FIELD OF THE INVENTION

This invention relates to the heating of bearings and other ring-like articles which are required to be located over shafts, pipes and the like.

BACKGROUND

Induction heating is well known in the art and has conventionally been achieved by means of apparatus which constitutes a primary winding of a transformer with the bearing ring forming the secondary winding. This is accomplished by providing a horseshoe construction for the primary winding and having a connecting piece to complete the circuit, the connecting piece being adapted to receive the bearing in inductive contact.

Many types of induction heaters are presently in use. Their use, however, is limited by several disadvantages derived from the fact that induction heating presently involves passing a high-power current, often of several kilowatts, through an inducting coil to effect high heat in tie conducting metal; and the primary winding is generally of normal supply
frequency and is generally of substantial size which makes it difficult to transport. Another disadvantage associated with prior art arrangements is that the bearing requires to be demagnetised during or after the heating operation.

It is an object of the present invention to obviate some of the disadvantages of the prior art and to provide apparatus which is easily portable and which does not magnetise a bearing or ring unduly.

THE INVENTION

According to the invention, an induction heater for a ring-like article includes a clamp-like magnetically inductive core, which can open to accommodate the article to be heated, a primary winding, and a source of high frequency electrical current, such as a switch mode supply.

In a preferred form of the invention the core is of ferrite.

The important advantage of the present invention is that due to the novel use of high frequency which may be generated by a compact high frequency generator, it can be made as a very small unit which is easily transportable. The high frequency current used, which involves low flux density in the core and bearing and in which the oscillations die gradually due to the resonant mode of operation, means that little or no magnetization takes place and a demagnetization step is avoided.

PRIOR ART STATEMENT

An EPO search revealed the following prior patents:

GB-A-1454783
EP-A-027306
US-A-4311896
US-A-3895295
US-A-3187155
EP--A-143091

none of which describe the present invention and rather tend to accentuate the inventive step since none of the prior art mentions the use of high frequency to obviate magnetisation.

EMBODIMENT OF THE INVENTION

An embodiment of the invention is described below with reference to the accompanying drawings, wherein;

Figure 1 is a diagrammatic, partially cutaway view of a heater for large bearings or ring-like forms according to the invention;

Figure 2 is a diagrammatic, partially cutaway view of a heater for small bearings or ring like forms according to the invention;

Figure 3 is a diagrammatic view of a temperature sensor for use in the invention;

Figure 4 is a diagrammatic view of the housing of the high frequency supply for use in the invention;

Figure 5 is a block diagram of a switch mode power supply for the heater.

Referring to Figure 1 and 2, a primary coil 10 is provided on the ferrite cores 12, which are hinged at 14 to enable the bearing or ring-like form to be fitted over either point A or point B. The primary coil 10 is associated with a switch mode power supply 40, and is connected to this by means of connector 16. A diagrammatic view of the housing for the switch mode power supply 40, is shown in Figure 4 and a block diagram of the circuit is shown in Figure 5. The ferrite cores 12 are enclosed in a heat resistant and non-electrically conductive housing 13.

Referring to Figure 3, two temperatures sensitive I.C.'s 18, are mounted on a spring clamp 20; one measures the temperature of the bearing or ring-like form, the other measures the ambient or reference temperature. The two I.C.'s 18 are associated with the switch mode power supply 40 and are connected to it by means of connector 22.

Referring to Figure 4, the switch mode power supply 40, is housed, in this form of the invention, in a aluminium case 24. The primary coil 10 is connected via socket 26 and the temperature sensors 18 are connected via socket 28. The mains

supply is connected through switch 30 and fuse 32. Temperature control of the sensors 18 is effected by means of a potentiometer 34. The switch mode power supply 40 is activated by push button 36 and an indication of the active state is made by the LED 38.

Referring to Figure 5, the mains current to the circuit of the switched mode power supply 40, is rectified 42 and smoothed using electrolytic capacitors 44 to produce a smooth DC current. This supply is then used to power a self-oscillating inverter circuit 46, the exact frequency of which is regulated by a control circuit 48, (the inclusion of such a circuit will be obvious to those skilled in the art), the resulting high voltage and high frequency current is then supplied to the primary coil 10, which then heats up any bearing or ring-like form 50, which is in inductive contact.

In one example of the invention, a ferrite core was selected which was suitable for use at frequencies of 20KHZ. Type Philips A320 KP 9012 was used of size 94mm in length, 27mm in width and 16mm in thickness and several were assembled together to form the heater as shown in Figure 1. These were wound with 15 turns of 2 x 1mm copper wire.

An auxiliary circuit is included to cause the main circuit 40 to run at a frequency that produces a power factor of 1 in the primary coil 10. This is to ensure that maximum power is always delivered to the load 50. (Under variable load conditions the power factor could change causing reduced power in the bearing or ring). This circuit also has the function of causing the transistors to switch at zero current, thus reducing the losses in them.

Variable temperature settings are obtainable with the control 34 and at the set temperature point automatic switch off of the switch mode power supply 40 is effected together with an audible buzzer. Measurement of the temperature rise can be shown using a liquid crystal display.

If, while setting up a workpiece to be heated, the circuit across the temperature sensor is incomplete or the temperature sensor was not fitted to the workpiece, a safety circuit will disable the switch mode power supply thereby inhibiting activation of said supply.

The invention allows high inductive heating with low power input.

The above embodiment herein discussed is not meant to limit the scope of the invention and its underlying theory. Other embodiments will be obvious to those skilled in the art.

Claims

1. An induction heater for a ring-like articles including a clamp-like magnetically inductive core which can open to accommodate the article to be heated, a primary winding, and a source of high frequency electrical current.

2. The induction heater according to claim 1 in which the high frequency electrical current is derived from a switch mode power supply.

3. The induction heater according to either of the above claims in which the core is made from ferrite.

4. The induction heater according to any of the above claims which consists of ferrite cores in a housing of heat resistant and non-electrically conductive material, one side of the heater being hinged to provide entrance of the article to be heated.

5. The induction heater according to any of the above claims including temperature sensors responsive to ambient and workpiece temperatures and automatic means to break the circuit and/or actuate an alarm.

6. The induction heater according to any of the above claims including a phase lock loop or like circuit to ensure that power transistors or the like fire at or near the zero voltage and amperage points in the cycle despite changes in the inductive characteristics of the primary coil resulting from varying sizes of workpieces to be heated.

7. The induction heater according to claim 5 or claim 6 which includes a safety circuit adapted to ensure that in the event of an incomplete circuit across the temperature sensors, the switch mode power supply cannot be activated.

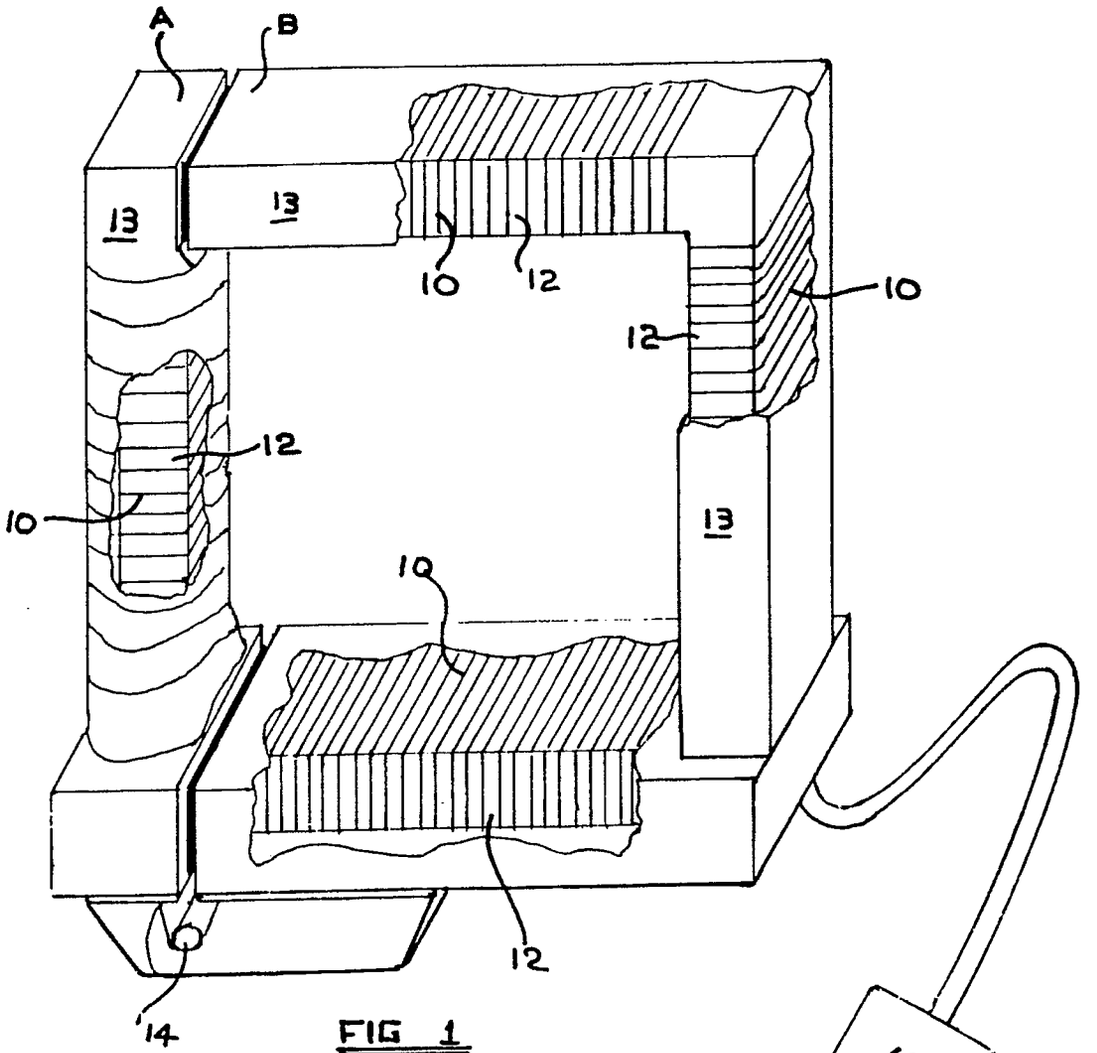
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FIG 1

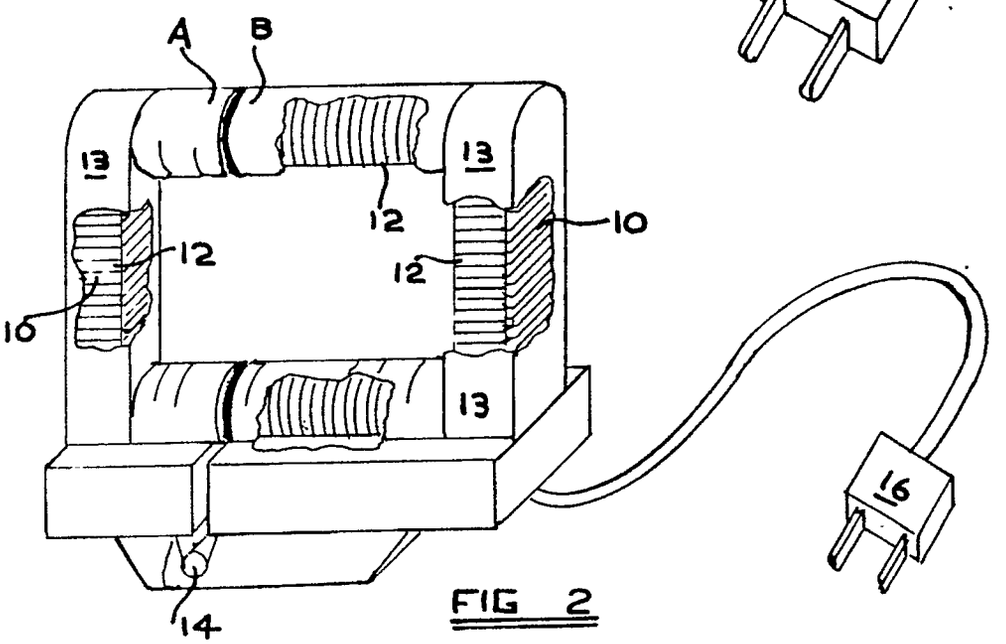
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FIG 2

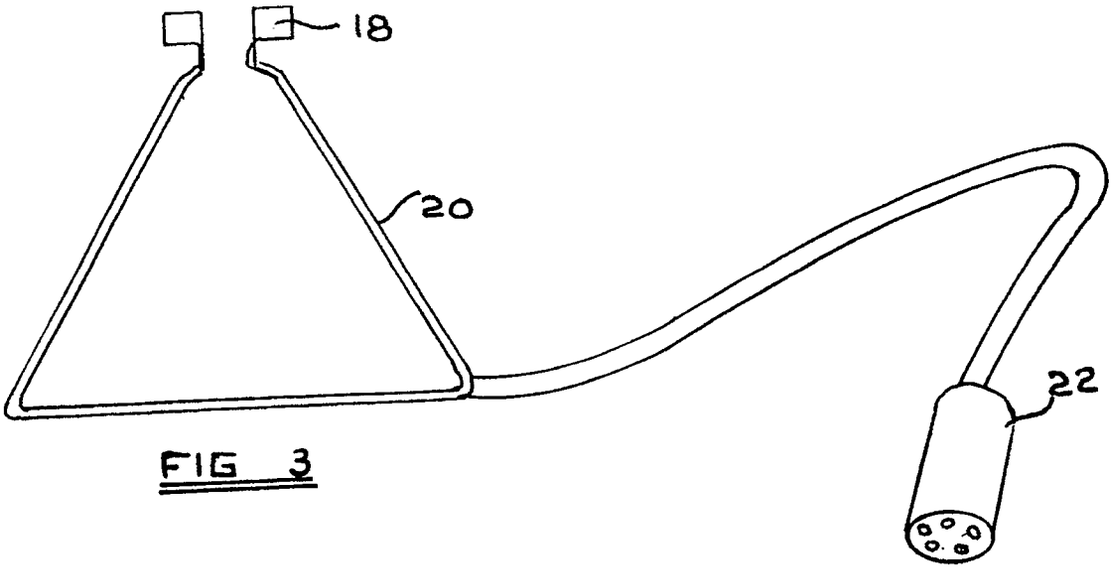

FIG 3

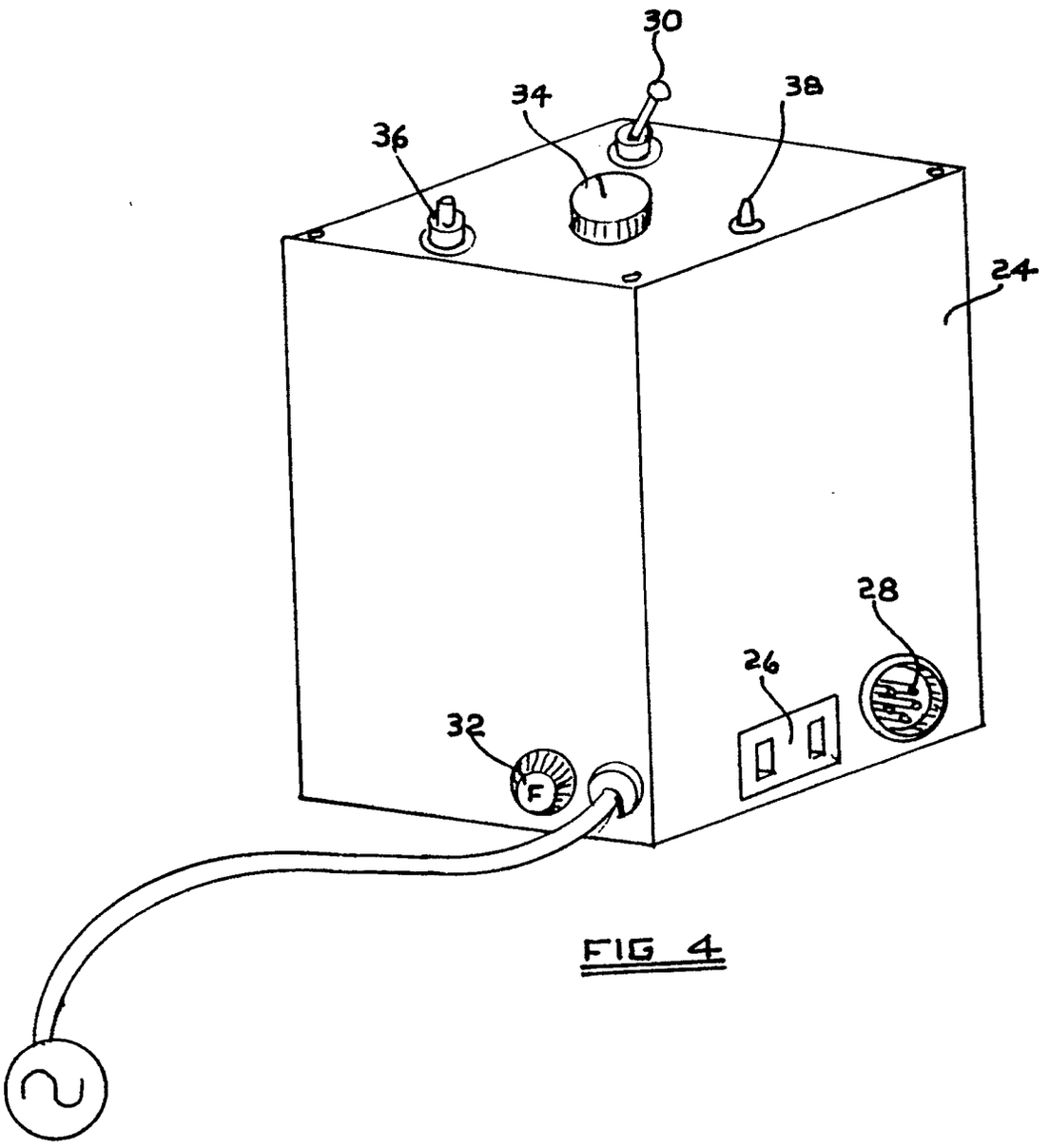

FIG 4

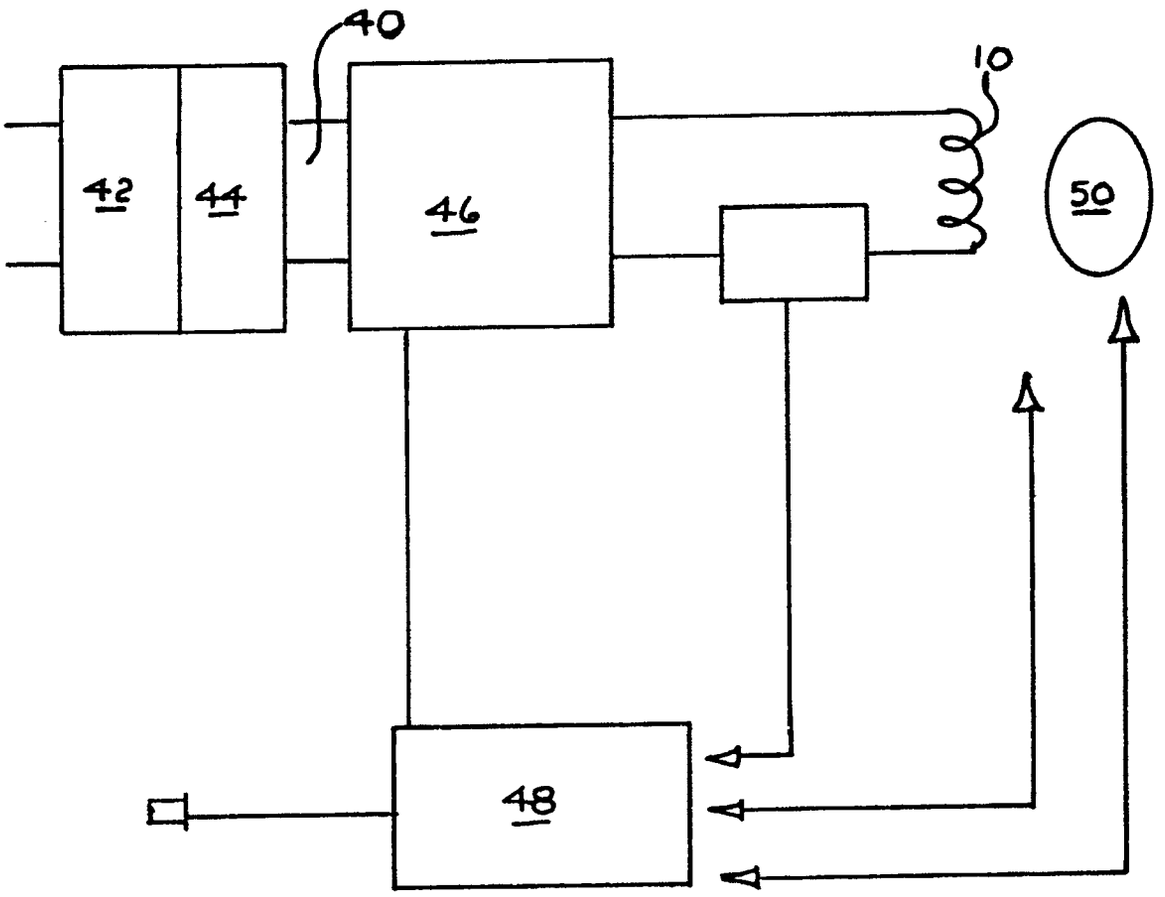

FIG 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 31 2365

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.5)
D,Y,A	GB-A-1 454 783 (ROTARY ELECTRICAL COMPANY LIMITED) * page 2, lines 20 - 72 * * page 2, lines 20 - 32; figures 1-4 *	1,4	H 05 B 6/10
D,Y,A	EP-A-0 027 306 (THE GOVERNMENT OF THE U.S.A. AS REPRESENTED BY THE ADM. OF THE N.A.S.A) * page 3, line 30 - page 4, line 35 * * page 3, line 36 - page 4, line 3 @ page 4, line 28 - page 5, line 1; figure 1 *	1,2,3	
D,A	US-A-4 311 896 (SETA JUNYA) * column 1, line 51 - column 2, line 36; figure 1 *	1,4,5	
D,A	US-A-3 895 295 (EUGENE MITTELMANN)		
D,A	US-A-3 187 155 (ERNST BECKERT ET AL.)		
D,A	EP-A-0 143 091 (SPM INSTRUMENT AB)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 05 B

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	08 March 91	RAUSCH R.G.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same catagory
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