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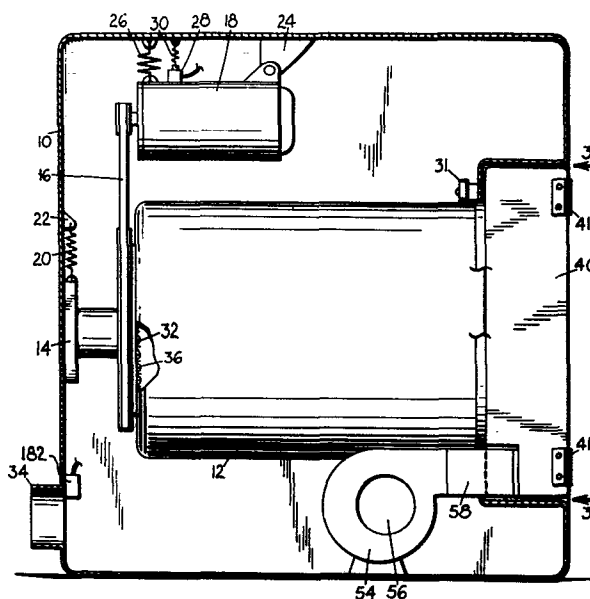
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54 **Tumble drying apparatus.**

57 The invention relates to apparatus for removing moisture from articles. A housing (10) rotatably supports a hollow drum (12) on substantially a horizontal axis whereby articles to be dried tumble around the interior of the drum when the latter is rotated. A microwave power mechanism (46) such as a magnetron, is provided in a door (40) for the housing and has an output portion thereof directed into the drum for heating and drying articles tumbling in the drum. An output portion (78) of the microwave power mechanism has a dielectric dome-like shield (84) mounted over it for deflecting tumbling articles away from such output. A forced air system (54) is provided for ventilating the interior of the drum, and such system includes a passageway extending adjacent to the power mechanism (46) to that such ventilating air also cools the power means. The present mechanism is associated with an electrical circuit having door interlocks, door panel interlocks, and other interlocks, as well as a magnetically operated door interlock that is substantially foolproof so that power from the microwave power mechanism is positively de-energised when the door is open. Circuitry is provided for the microwave power mechanism to protect it from excess average and peak reflected power. The circuitry also includes a humidity sensor to prevent excessive drying.



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"TUMBLE DRYING APPARATUS"

This invention relates to apparatus for removing moisture from articles and pertains particularly to
5 tumble drying apparatus having a hollow drum which is rotatably driven on substantially a horizontal axis and which is arranged to receive and tumble articles to be dried.

According to the present invention there is
10 provided an apparatus for removing moisture from articles comprising a hollow tumbler-type drum arranged to receive articles from which moisture is to be removed, said drum having an unobstructed end opening, support means supporting said drum on substantially a horizontal
15 axis, and drive means arranged to rotate said drum whereby articles being treated tumble across the interior of said drum, characterised by microwave power means on said support means disposed with the output thereof pointed in an axial direction directly into said drum
20 through said end opening for engaging articles tumbling across said rotating drum for removing moisture therefrom, an electric circuit for said power means, control means in said circuit for said power means, and forced air means in said apparatus moving heated air through said
25 drum for carrying away moisture within said drum.

The invention employs a novel concept of using microwave power as a drying and heating medium.

More particularly the invention provides a mechanism of the type described that utilizes a hollow
30 drum which is rotatably supported on substantially a

horizontal axis and which is arranged to tumble articles therearound while being treated with the microwave power.

Further the invention provides a novel forced air system which serves both to ventilate articles being
5 tumbled as well as to cool the microwave power means.

Still further the invention provides a novel output for the microwave power means which is arranged to protect such power means from tumbling articles as well as from abnormal reflected power.

10 Yet still further the invention provides circuit elements in the circuit to the power means arranged to protect the power means from excessive average reflected or peak VSWR; to provide humidity sensing means arranged to turn off the power means at a selected dried condition
15 of the articles being treated; and to provide other safety features which include a foolproof magnetically operated door switch that turns off the power to the microwave power means when the door is opened, and means arranged to turn off such power means if the article
20 receiving drum should accidentally be subjected to an abnormal weight.

The invention will now be described further hereinafter by way of example only, with reference to the drawings, in which:-

25 Figure 1 is a front elevational view of apparatus with which the present invention may be employed;

Figure 2 is an enlarged vertical sectional view of the apparatus taken on the line 2-2 of Figure 1;

Figure 3 is a fragmentary elevational view, partly broken away, taken on the line 3-3 of Figure 2;

Figure 4 is a vertical fragmentary sectional view taken on the line 4-4 of Figure 3;

5 Figure 5 is a fragmentary end elevational view taken on the line 5-5 of Figure 4;

Figure 6 is an enlarged fragmentary sectional view taken on the line 6-6 of Figure 3;

10 Figure 7 is an enlarged fragmentary sectional view taken on the line 7-7 of Figure 3;

Figure 8 is a schematic view of electrical circuitry associated with the present mechanism; and

Figure 9 is a schematic view of a modified circuit which may be associated with the present mechanism.

15 With particular reference to the drawings, and first to Figures 1-7, one particular application of the present microwave treating mechanism is illustrated. One such application comprises the association of microwave power means for heating and drying articles being
20 tumbled in a rotating drum, such as in association with clothes dryer mechanism using a tumbler as in present day use. The mechanism comprises a housing 10 or other support means having a hollow drum or tumbler 12, preferably microwave opaque, supported therein on
25 substantially a horizontal axis. As best seen in Figure 2, such drum is supported for rotation on a rear bearing assembly 14 supported in the housing. The drum is driven by a belt and pulley assembly 16 associated with a drive motor 18. A feature of the invention is a spring suspension support for the bearing

means 14, such as by one or more equally spaced tension or compression springs 20, secured to support brackets 22 on the housing, as well as a pivot support 24 at one end of the motor and a tension spring support 26 at the other end. Motor 18 has a switch housing 28 secured thereto having a spring held contact assembly 30 connected at its other end to the housing 10. The spring suspension of the bearing 14 and the motor 18, as well as the spring contact assembly 30, is arranged such that if an abnormal load should be present in the drum 12, such as an overload of articles or if a child should crawl into the drum, switch 28 will open the circuit to power means to be described. The front of the drum has suitable rotatable support in the housing such as by a plurality of bearing mounted rollers 31.

The rear of the drum 12 has an opening 32 through which air used to ventilate articles within the drum can flow out and be discharged through a rear outlet 34. Rear opening 32 is covered by a screen 36 to prevent or reduce leakage of microwave power from the drum to the door housing.

Housing 10 has a loading door 40 supported by hinges 41. Such door has a substantial thickness between its front panel 42 and its rear panel 44 so as to enclose microwave power means 46, such as a magnetron, supported on a base plate 48 disposed above the bottom of the door and contained within an enclosure 50 forming an enclosed area for the magnetron in combination with the front and rear panels of the door as well as with one side of the door.

A blower 54 having an inlet 56 is mounted adjacent to the bottom of the housing 10 and has an outlet 58 communicating with the enclosure 50 when the door 40 of the mechanism is closed. Rear panel 44 of the door has an outlet opening 60 within the enclosure 50 communicating with the open end of the drum 12. By operation of the blower 54, air is arranged to be circulated through the housing 50, into the drum 12, and out the outlets 32 and 34. Opening 60 preferably is covered by a screen material 62 to prevent or reduce leakage of microwave power from the drum to the door housing. Magnetron 46 preferably has cooling fins 64 to achieve maximum cooling from the air flowing through the enclosure 50. Since the forced air system for ventilating the drum 12 also moves past the magnetron 46 for cooling the latter, such forced air serves a dual purpose.

Magnetron 46 has an output dome 70, and according to the present invention, such output dome is associated with a transition section 72 of coaxial line which in turn leads to a directional coupler 74 in turn connected to a three stub coaxial tuner 76 which acts as a matching section between the coaxial line portion of the system and a cylindrical wave guide 78 to the rearward end of which, Figure 5, is provided with a horseshoe shaped slot 80. Slot 80 acts as a slot-type antenna and serves as a coupler between the wave guide 78 and the cavity or space formed by the drum. One feature of the wave path 72, 74 and 76 is that such path is elongated so as to get good wave distribution as well as to lessen the possibility of reflected wave damage to the magnetron

46.

With reference to Figure 4, a feature of the invention also resides in the provision of a dome-like shield 84 of dielectric material secured on the rear panel 44 of the door over the end of the cylindrical wave guide 78. This shield serves to protect the end of the wave guide physically from tumbling articles in the drum and also serves to space tumbling articles from such wave guide so as to keep objects a minimum wave length distance away from the microwave coupler and thus out of the coupler's near field. Such prevents perturbations of the near field by articles in the dryer from providing increases in the average reflected power or voltage standing wave ratio which may be damaging to the magnetron. The shield 84 can be of any shape, it being preferred that the shape used provide a minimum spacing from articles in the drum to the coupler of at least one half to one wave length. It is preferred that the shield 84 have a sealed fit with the wall 44 so as to protect the coupler from dirt and moisture.

With reference to Figure 6, the inner panel 44 of the door has inwardly facing edge sockets 86 for receiving first a rubber gasket 88 or the like to provide a tight seal with the housing 10 at the door opening 40a of the housing and second an RF gasket 90 which serves to prevent the outflow of power from the tumbler. A further choke for the outflow of power is provided by an air space 92 formed between an annular baffle 94 secured to the inner surface of the housing 10 and extending parallel with the drum surface.

In addition to known interlocks, it is desired that a substantially foolproof interlock be provided so that the power will not likely be on at any time that the door is open. For this purpose, and with
5 reference to Figures 3 and 7, a switch housing 100 is mounted on the rear door panel 44 and encloses a reed switch 102 in the main circuit to the magnetron. Disposed adjacent to the reed switch 102 within the
10 switch housing 100 is a socket 104 that opens through the panel 44. Associated with the socket 104 is a magnet 106 secured on the front wall of the housing 10 whereby with the reed switch 102 being constructed of magnetically actuatable material, and in an arrangement wherein such switch will normally be open but will close upon entrance
15 of the magnet in the socket 104, the main circuit to the power means will open as soon as the door is opened. In order to provide a foolproof arrangement, it is preferred that the socket 104 and the projecting magnet 106 have a substantially exclusive interfitting relation such as
20 a triangular cross section or other shape which would be difficult to match. In addition, this arrangement of door interlock can also have a magnetic power relation such that the magnet must be of a selected power to actuate the reed switch. This would add even a greater
25 foolproof arrangement for the power circuit.

Reference is now made to Figure 8 which shows circuitry for the dryer. Such circuitry includes infeed lines 110 and 112 providing power to an auto/isolation transformer 114 in turn supplying power to a transformer

116 for the filament 118 of the magnetron 46. Infeed line 110 includes a main switch 120, a control panel interlock switch 122, and a timer switch 124. A power indicating lamp 126 is connected in parallel across
5 the infeed lines. Blower motor 54 and drum motor 18 are in circuit with a start switch 130 also including a time delay switch 132 the control device 134 of which is connected across the primary of transformer 114.

A latching relay 138 is connected in series with the
10 start switch 130. The energization of relay 138 closes a contact 140 thereof which latches said relay and continues the supply of power to a drive motor 124a for the timer 124. An indicating lamp 142 is connected in the timer circuit.

15 In the operation of the circuit thus far described, the timer 124 is first set to the desired drying time, and assuming that switches 120 and 122 are closed, the start button 130 is pressed. Such latches relay 138 to supply power to the blower motor 54 and drum motor 18
20 as well as the timer motor 124a. The timer motor then proceeds to run until the desired drying time is up at which time the switch 124 is opened to remove the power from the transformer 114 and thus power to the magnetron 46. The time delay 134 maintains the switch 132 closed
25 for a short while after the power to the magnetron is turned off so that the blower motor 54 and the drum motor 18 continues to operate for a specified time to ensure that the magnetron is cooled.

Filament transformer 116 is connected across the input to the magnetron power supply derived from the auto/isolation transformer 114. A time delay device 146 is connected across the primary of transformer 116 and a pair of contacts 148 of such time delay are connected in series with the output of the transformer 114. Upon supplying power to the transformer 114 and thus to time delay 146, the latter provides a pre-set time delay to allow the magnetron filament 118 sufficient time to warm up before contacts 148 close allowing voltage to be supplied to the magnetron 46.

The power supply to magnetron 46 includes a bridge rectifier 150 connected in the output circuit of the transformer 114. The output of the rectifier is connected to a capacitor 152 and bleeder resistor 154 for generating a DC voltage at the top end of a pulse transformer 156 supplying pulsed power between the cathode 158 and the anode 159 of the magnetron. Conventional regulating means 160 for supplying DC power of the required value to control circuitry now to be described is included in the magnetron circuit.

The present invention includes protective circuits for the magnetron which operate through the use of pulse modulation of the magnetron. The magnetron is pulse modulated through the action of an electronic switch 164 connected to the primary of pulse transformer 156 (whose secondary is connected between the cathode 158 and the anode 159 of the magnetron) and arranged to rapidly open and close the circuit formed by the DC power supply and pulse transformer and a variable pulse

width multivibrator 165 acting through AND gate 166 associated with other inputs to be described. In normal operation, the other inputs to the AND gate 166 are such that upon a pulse from multivibrator 165 switch 5 164 is closed thus providing through the transformer action and design of the pulse transformer 156 a pulse of power (of proper voltage, polarity, and current) to the anode of the magnetron and of the same duration as the pulse from multivibrator 165. With zero input 10 to multivibrator 165 the pulse duration is such that the average power from the magnetron when operating into a matched load is the desired value; thus any decrease in pulse width will be reflected as a decrease in average output power. The switch 164 may be a switch which is 15 electrically controllable and fast enough operating. Examples are Hex Fet and VMOSFet switches.

A first protective circuit for the magnetron, designated generally by the numeral 170 includes a magnetron thermal protector switch 172 of conventional 20 construction and various interlock switches such as the door interlock switch 102 shown in Figure 7, door panel interlock switch 174, and other interlock switches 176.

Circuit 170 also includes a contact 179 operated 25 by the relay 138 and acting as a control to the pulse modulator switch 164 along with the other switches in series therewith. Contact 179 serves as a direct turn-off for the magnetron as soon as the relay 138 is de-energized.

Also in the circuit 170 is humidity sensor means arranged to control operation of the switch 164 through the gate 166. Such sensor means comprises a first humidity sensor 180 located in the path of the inlet air to the clothes dryer, such as in the portion 58 or 60 shown in Figure 3, and a second humidity sensor 182 located in the path of the outlet air of the dryer such as adjacent to the outlet 34 shown in Figure 2. The outputs of the humidity sensors 180 and 182 are fed to the two inputs of a difference amplifier 184, and the output of such amplifier is fed to a comparator 186 which compares such output to a reference input 188. The system can be arranged such that when the output of the two humidity sensors becomes equal or differ by a specified amount, the output of the difference amplifier goes below the reference voltage and the comparator's output of the comparator 186 to an AND gate 190 whose other input is connected to a logic generator 192 and whose output is connected to the series chain of interlocks in the circuit 170 and can shut the magnetron off at the AND gate 166 associated with pulse modulator switch 164, the humidity sensing means in the circuit 170 serves to prevent articles in the drum from being overdried or at least dried to a specified amount.

In addition to the circuitry described, the pulse modulated magnetron as controlled through the pulse modulator electronic switch 164 allows the use of additional protective circuits to prevent the magnetron from being subjected to excessive reflected power. Such additional circuits can be operated through the AND

gate 166 along with the circuit 170.

A first of such protective circuits comprises a circuit 194 arranged to sample the average reflected power in the transmission line or wave guide connected to the magnetron. Such circuit comprises a sensor 196 of conventional design and located in the directional coupler 74, for example, Figure 3, and arranged to sample the reflected power in such coupler. Such sensor provides a signal proportional to the reflected power and such signal is in turn averaged over a number of pulses by an integrator 198. The averaged signal from the integrator is then fed to one input of a difference amplifier 200 whose other input 202 is connected to a reference voltage. The output of amplifier 200 feeds into the variable pulse width multivibrator 165 connected to the AND gate 166. When the average reflected power signal exceeds a value determined by the reference, a signal is produced which is proportional to the amount that the average reflected power exceeds the reference level determined by the reference. The gain of the difference amplifier is sufficient enough that a small increase in the average reflected power above the reference will provide enough signal at the width control input to the pulse width multivibrator 165 so as to reduce the pulse width from its maximum value to a value such as to keep the average forward and hence the reflected power below its maximum allowable value. If the average reflected power should exceed a preset level as determined by reference voltage 202 and a regulating

band determined by the gain of amplifier 200 and the voltage input required to reduce the pulse width of multivibrator 165 to zero, the pulse width of the pulse output of multivibrator 165 will become zero, thus turning completely off AND gate 166 and hence switch 164. This in turn de-energizes the magnetron.

Another protective circuit for the magnetron which operates through the AND gate 166 comprises a circuit 210 for protecting the magnetron from peak voltage standing wave ratios in excess of the source capabilities. Circuit 210 comprises a sensor assembly 212 in the transmission line such as in the directional coupler 74, Figure 3, containing structure to sample and detect a signal which is proportional to the forward power. This signal along with the reflected power signal derived from sensor 196 is fed to an operational amplifier 214 hooked up so that its output is proportional to the ratio of the reflected power signal to the forward power signal and thus a measure of the voltage standing wave ratio in the transmission line connected to the magnetron. The output signal of the amplifier is fed to a comparator 216 whose other input 218 is connected to a reference voltage. When the signal from the ratio amplifier exceeds the reference voltage, the comparator's output opens the AND gate 166.

Circuit 210 as well as circuit 194 causes the magnetron to be turned off partially or completely only during the undesirable periods which if temporary will only amount to a momentary shut down. These circuits

were designed to protect the magnetron from voltage standing wave ratios which may be in excess of the source capabilities such as may happen in the event that a metal object, for example, is in a load to the
5 dryer. Although circuits 194 and 210 are shown herein in conjunction with a dryer mechanism employing a tumbler which presents articles to be dried to the output power of the magnetron, such circuits could as well be applied to other mechanisms such as conventional microwave ovens
10 for protecting the magnetron from excessive average reflected or peak standing wave ratios.

Sensors 196 and 212 may comprise suitable and conventional sensing devices such as a diode rectifier which converts the RF energy provided by the directional
15 coupler to a DC voltage.

Figure 9 shows an alternative form of circuit 194' for controlling the average and peak reflected powers to the magnetron. In this circuit, the output from the pulse transformer 156 is connected to a rectifier filter
20 so as to become a switching power supply. The integrator is eliminated and its function is solved by an inductor connected to a capacitor 222 and bleeder resistor 224. In this circuit a diode 225 acts as a rectifier whose output is connected to an LC filter comprised of inductor
25 220 and capacitor 222. Diode 226 acts as a commutating diode. In the circuit of Figure 9, the magnetron power output is now controlled by anode voltage which decreases as the pulse width decreases.

15.

It is to be understood that the forms of our invention herein shown and described are to be taken as preferred examples of the same and that various other changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of our invention, or the scope of the subjoined claims. For example, it is within the concept of the invention to mount the magnetron in the housing rather than in the door, it merely being necessary as one example that an RF connection which is supplied by a flexible coaxial line extend from the magnetron in the housing to a suitably mounted wave guide.

CLAIMS

1. Apparatus for removing moisture from articles comprising a hollow tumbler-type drum arranged to receive articles from which moisture is to be removed, said drum having an unobstructed end opening, support means
5 supporting said drum on substantially a horizontal axis, and drive means arranged to rotate said drum whereby articles being treated tumble across the interior of said drum, characterised by microwave power means (46)
10 on said support means disposed with the output thereof pointed in an axial direction directly into said drum (12) through said end opening for engaging articles tumbling across said rotating drum for removing moisture therefrom, an electric circuit for said power means,
15 control means in said circuit for said power means, and forced air means (54) in said apparatus moving heated air through said drum for carrying away moisture within said drum.

2. Apparatus as claimed in claim 1, wherein said support means includes a door (40) disposed adjacent
20 to said end opening of said drum (12), said power means (46) being supported on said door (40).

3. Apparatus as claimed in claim 1, wherein said support means includes a housing (10) for said drum (12) and a door (40) on said housing disposed adjacent to
25 one end of said drum means (72,74,76) for coupling energy from said microwave power means (46) to said drum mounted on said door, an RF gasket (90) between said door and said housing arranged to choke off power from said microwave power means leaking through the joint between
30 said housing and door, and a separate gasket (88) of resilient material between said door and said housing to seal off the leakage of air through the joint between said housing and door.

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4. Apparatus as claimed in claim 1, wherein said support means includes a housing for said drum (12) and a door (40) on said housing disposed adjacent to one end of said drum, said power means (46) being supported
5 on said door, means (72,74,76) for coupling energy from said microwave power means to said drum supported on said door, and choke means (92) between said drum and housing arranged to choke off power from said microwave power means leaking through the joint between said drum
10 and housing and thence to the exterior of said support means.

5. Apparatus as claimed in claim 1, wherein said support means includes a housing for said drum and a door on said housing disposed adjacent to one end of
15 said drum, said drum having an opening facing said door, said door having means (72,74,76,78) coupling the energy from said microwave power means to a cavity formed by said drum, and a dome-like shield (84) transparent to microwaves mounted on said door and covering said
20 coupling means (78), said shield being of a size and shape to keep the tumbling articles being dried out of the near field of said coupling means.

6. Apparatus as claimed in claim 1, wherein said forced air means (54) includes air inlets (58) into
25 said support means and drum, an air outlet (32) from said drum, and a passageway between said inlet and outlet, said passageway extending adjacent to said power means in an arrangement such that forced air that removes moisture from said drum, cools said power means and said
30 power means in being cooled causes said forced air to be heated before its entry into said drum to increase the vapour carrying capabilities of said forced air.

7. Apparatus as claimed in claim 6, wherein said power means comprises a magnetron, said magnetron having
35 outwardly projecting fins (64) for cooling by said forced air.

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8. Apparatus as claimed in claim 1, wherein said drum is arranged to receive articles of clothing whereby said treating mechanism is usable as a clothes dryer.

9. Apparatus as claimed in any preceding claim,
5 including spring suspension means (20,26) supporting said rotatable drum in said support means, and switching means (28,30) in said electric circuit arranged to open the circuit to said power means upon downward movement of said drum with said spring suspension means resulting
10 from an excess load weight in said drum.

10. Apparatus as claimed in claim 1, wherein said power means comprises a magnetron having an output, said power means also comprising a cylindrical wave guide coupler (72,74,76,78) directed into said drum, said
15 output and cylindrical wave guide coupler being connected by means of a wave path consisting of a transition section (72) leading from said output for impedance matching, a directional coupler (74) leading from said transition section for providing signals proportional
20 to forward and reflected power required by said control means, and a tuner (76) between said directional coupler and said cylindrical wave guide coupler for impedance matching to the load presented by said drum, thus protecting said magnetron from excessive average
25 reflected power and peak VSWR.

11. Apparatus as claimed in claim 1, including a wave path between said microwave power means and its output into said drum, means (212,196) in said wave path to detect forward and reflected power, and pulse width
30 control means in said electric circuit for said power means arranged, using the signal proportional to reflected power, to provide pulse width modulation in an arrangement such that average reflected power for said power means will be maintained below the maximum allowable value for

19.

said power means by decreasing the pulse width in proportion to the increase in average reflected power.

12. Apparatus as claimed in claim 11 including switch means in said circuit arranged to break the
5 power to said power means, said pulse width control means being arranged to open said switch means upon receiving an excessive peak reflected power.

13. Apparatus as claimed in claim 11, including switch means in said circuit arranged to break the
10 power to said power means, said pulse width control means being arranged, using both the signal proportional to reflected power and the signal proportional to forward power, to open said switch means when excessive peak voltage standing wave ratio occurs.

15 14. Apparatus as claimed in claim 1, wherein said forced air means (54) includes an air inlet into said drum and an air outlet from said drum, said mechanism also including humidity sensor means in said circuit, said humidity sensor means comprising a
20 humidity sensor in said air inlet and a humidity sensor in said air outlet, means for taking the difference between the output of said two sensors, means for comparing said difference to a preset value corresponding to a desired dried condition of articles in said drum,
25 and switching means in said circuit arranged to break the circuit to said power means when said difference substantially equals said preset value.

15. Apparatus as claimed in any preceding claim wherein said drum is microwave opaque.

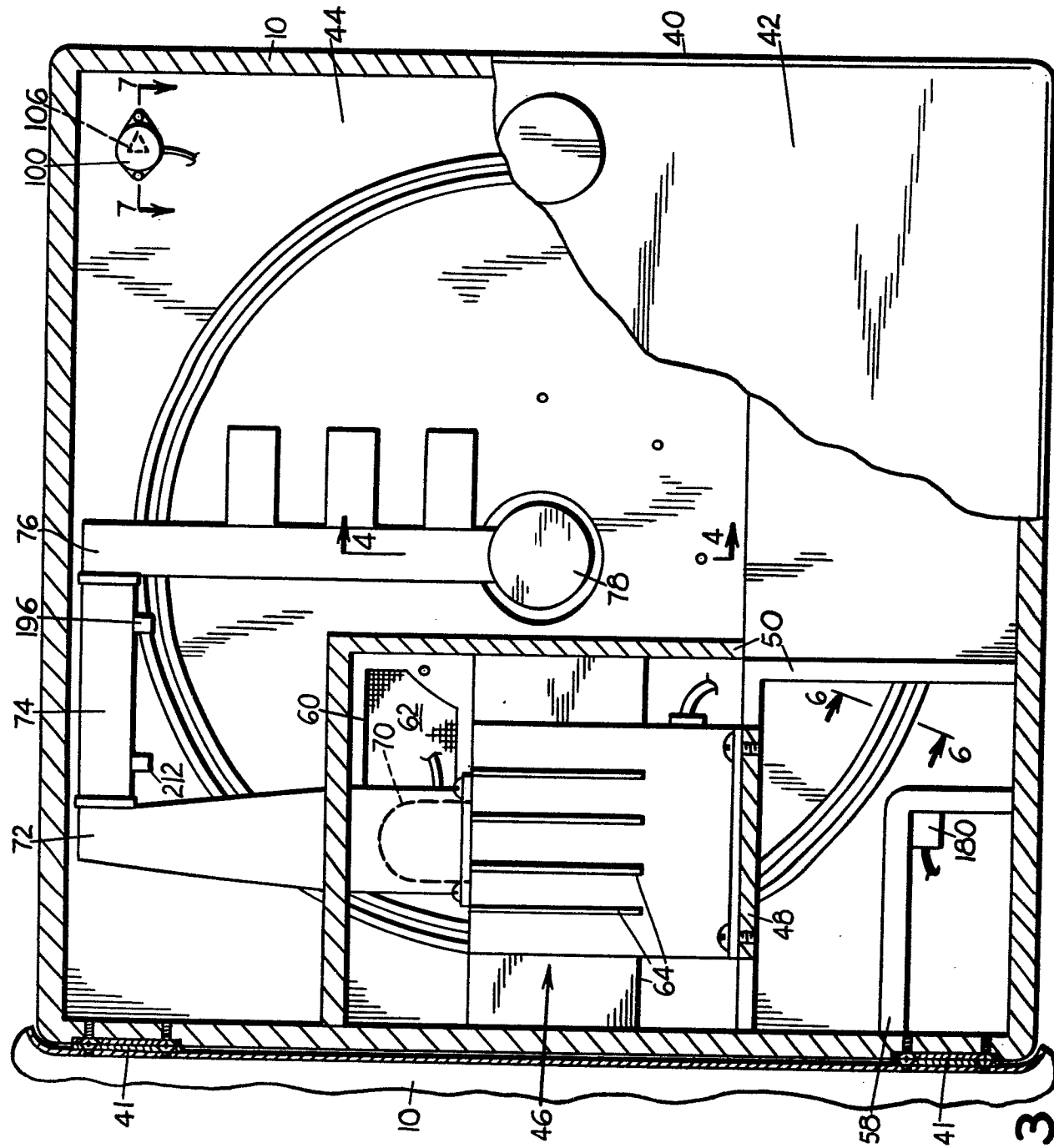


FIG. 3

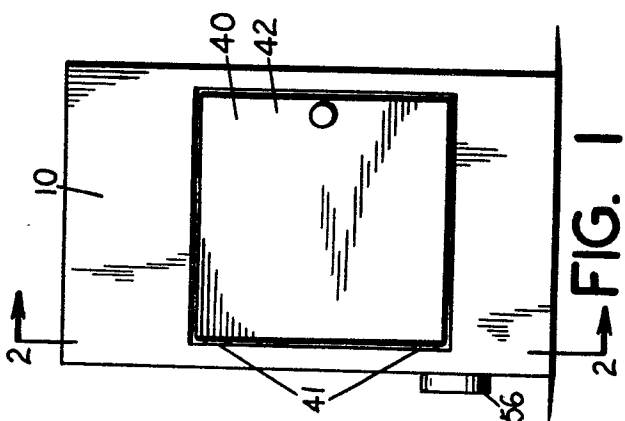


FIG. 1

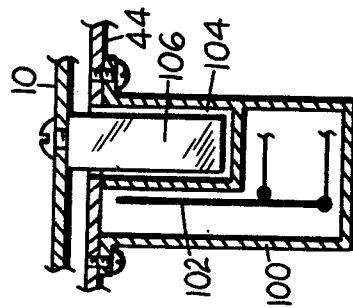


FIG. 7

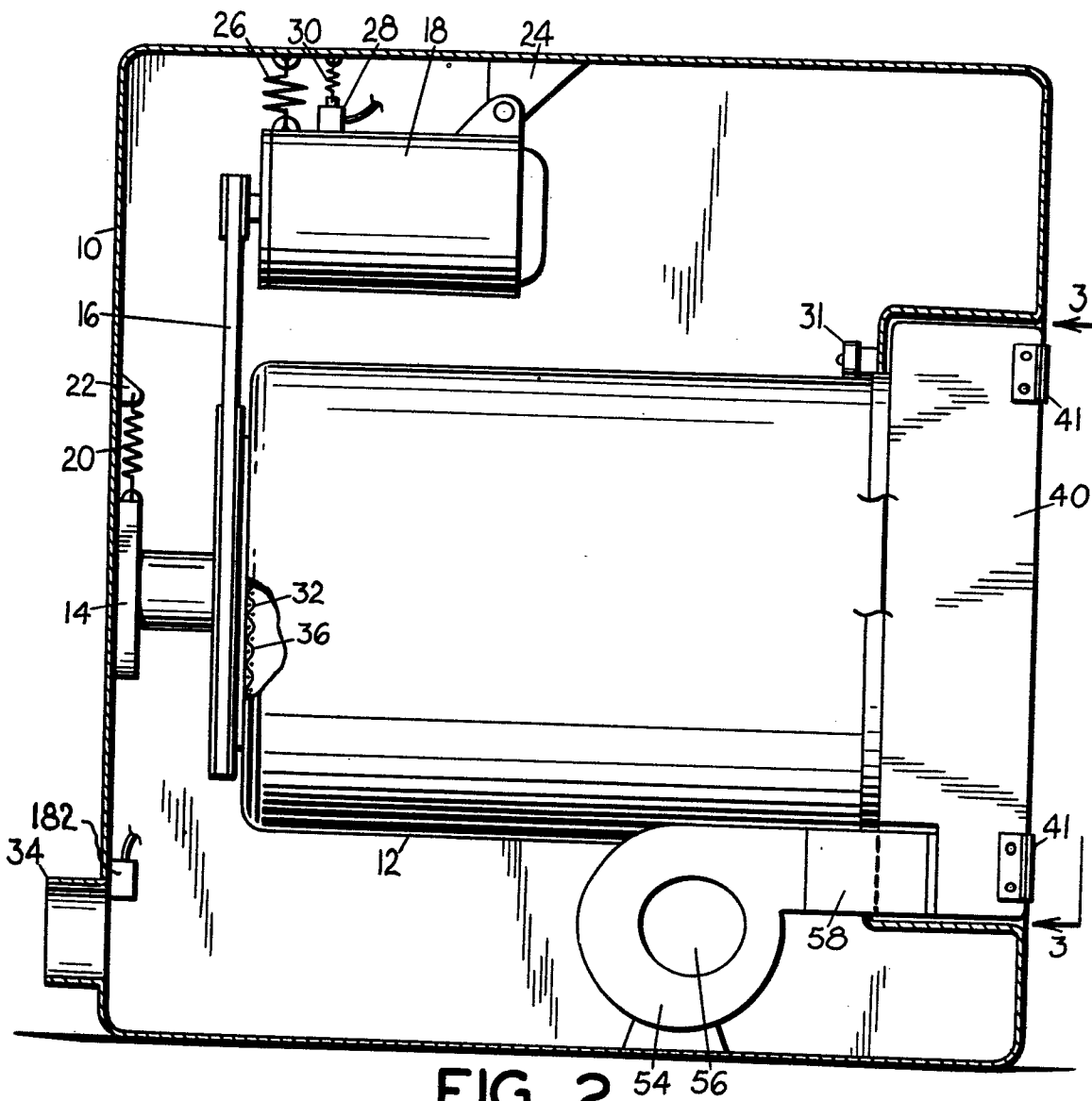


FIG. 2

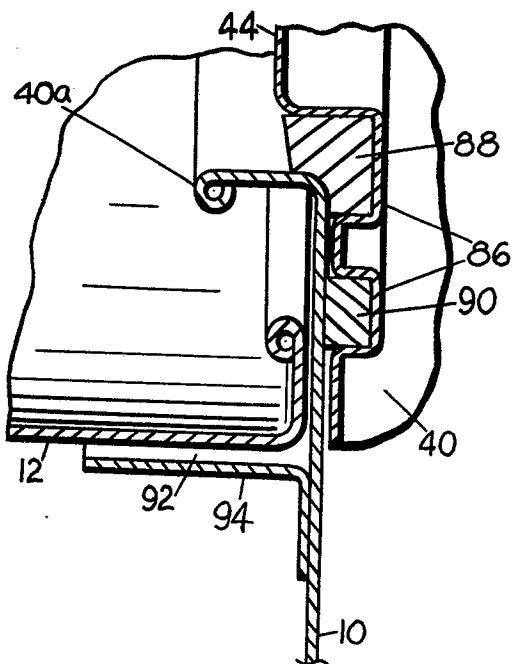


FIG. 6

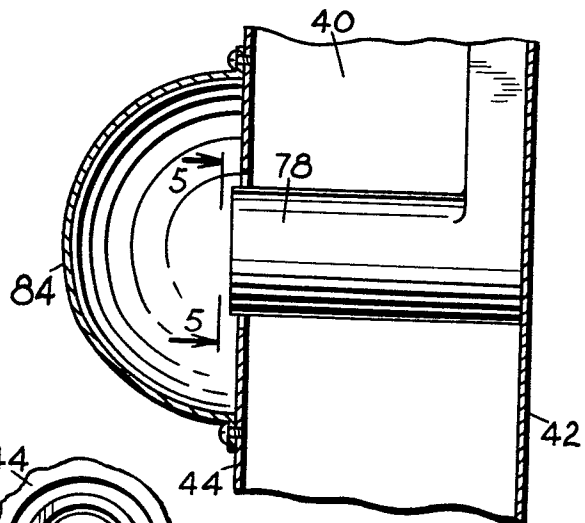


FIG. 4

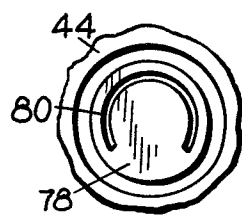


FIG. 5

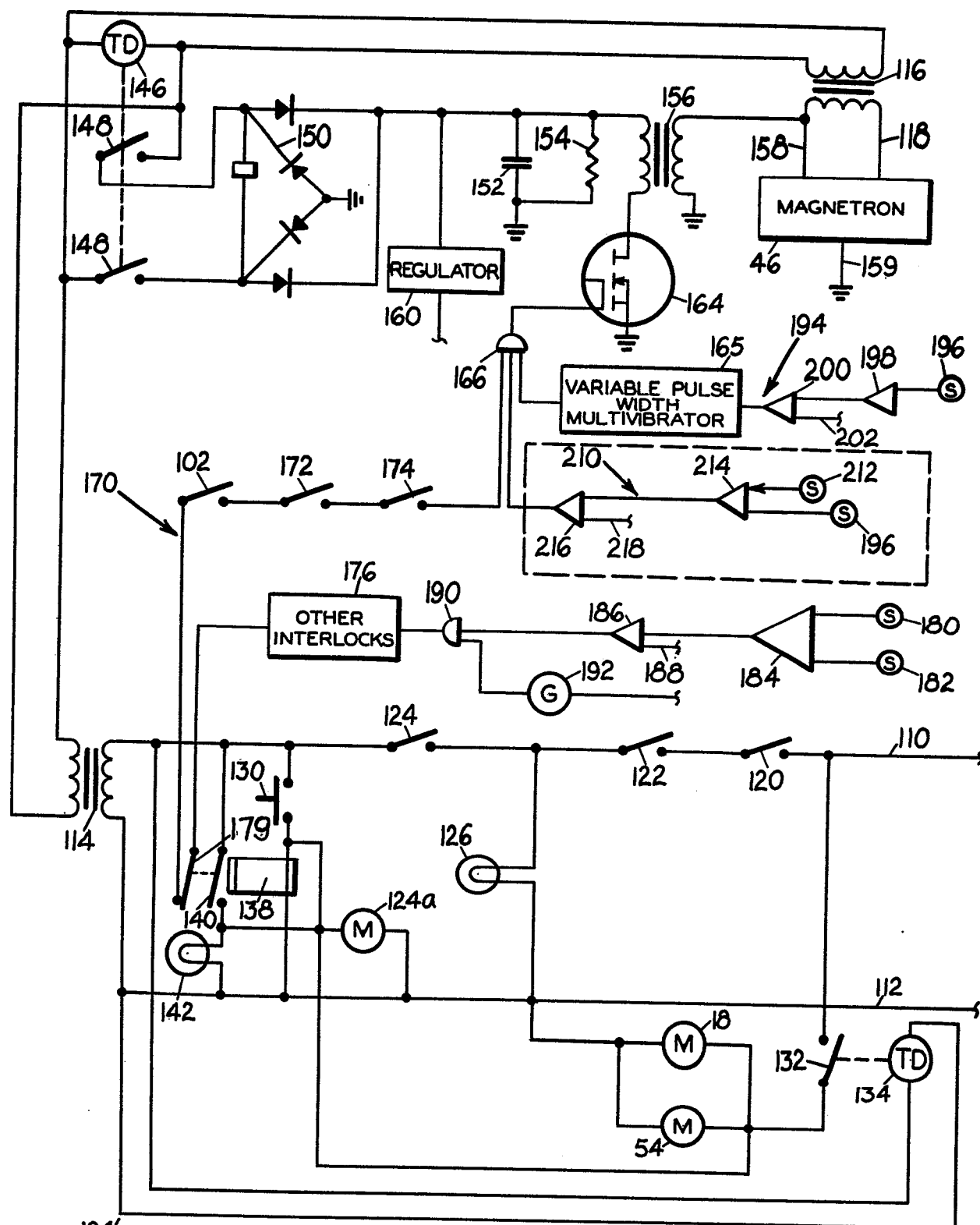


FIG. 8

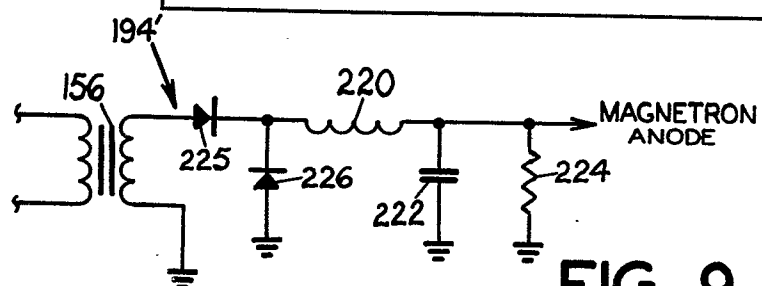


FIG. 9



European Patent
Office

EUROPEAN SEARCH REPORT

0088175
Application number

EP 82 30 1154

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. 3)
X	CA-A-1 092 198 (TOYNE) * Whole document *	1, 2, 4- 5, 8, 14 , 15	D 06 F 58/02 F 26 B 3/34 H 05 B 6/80
X	US-A-3 410 116 (LEVINSON) * Column 2, lines 8-27, 40-72; column 3, lines 1-38; column 4, lines 32-75; column 5, lines 1-22 *	1, 5-8	
Y	DE-A-1 610 307 (H. ZANKER) * Page 6, line 3 - end; page 7; page 8, lines 1-16; page 10, line 7 - end; pages 11-14 *	1-8, 14 , 15	
Y	DE-A-1 610 314 (H. ZANKER) * Pages 5-8 *	1-8, 14 , 15	TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
X	DE-A-2 818 693 (BALTES) * Claims 1-7, 11; page 18, lines 8-23 *	1, 5-8	D 06 F H 05 B
E	US-A-4 334 136 (MAHAN et al.) * Whole document *	1-15	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17-05-1983	Examiner D HULSTER E.W.F.
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. ³)	
E	US-A-4 356 640 (JANSSON) * Column 3, lines 1-58; column 4, lines 42-68, column 5, lines 1-42 *	1-5, 8, 10-15		
A	--- US-A-3 854 219 (STAATS) * Column 9, lines 31-38; column 10, lines 31-68; column 11; column 12, lines 1-29 *	1, 3, 6, 8, 10-13		
A	--- US-A-3 448 232 (KLUCK) * Column 5, lines 71-75; claims 1, 5 *	3, 4		
A	--- US-A-4 081 647 (SUMNER HALE TORREY) * Figures; column 3, lines 36-42 *	3, 4		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	--- US-A-3 678 238 (YOSHIO YASUOKA) * Column 2, lines 50-75; claim 1; figures *	3, 4, 6, 7		
A	--- US-A-3 127 494 (KELLOUGH) * Figure 3 *	5		
The present search report has been drawn up for all claims				
Place of search THE HAGUE		Date of completion of the search 17-05-1983	Examiner D HULSTER E.W.F.	
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. 3)
A	FR-A-2 487 623 (ELECTRICITE DE FRANCE) * Claims *	10-13	
A	US-A-4 210 795 (LENZ) * Column 4, lines 21-58; column 7, lines 31-38 *	10-13	
A	FR-A-2 312 067 (MATSUSHITA ELECTRIC) * Claim 1 *	14	
A	US-A-3 269 027 (HARN DEN JR.) * Column 1, lines 32-49 *	14	
A	US-A-2 381 894 (FERRIS) * Figures *	9	
A	US-A-3 936 622 (McELROY) * Abstract *	9	
A	GB-A-2 023 313 (BERSTORFF)		
A	GB-A-1 400 895 (CANADIAN PATENTS AND DEVELOPMENT)		
A	US-A-3 626 135 (FITZMAYER)		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17-05-1983	Examiner D HULSTER E.W.F.
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DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
A	US-A-3 276 138 (FRITZ) -----	
		CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
The present search report has been drawn up for all claims		
Place of search THE HAGUE	Date of completion of the search 17-05-1983	Examiner D HULSTER E.W.F.
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