

(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 199922585 B2
(10) Patent No. 740836

(54) Title
Method for treating an item

(51)⁷ International Patent Classification(s)
A61L 002/00

(21) Application No: **199922585**

(22) Application Date: **1999.02.04**

(87) WIPO No: **WO99/39751**

(30) Priority Data

| (31) Number | (32) Date | (33) Country |
|---------------|-------------------|--------------|
| 216/98 | 1998.02.06 | AT |

(43) Publication Date : **1999.08.23**

(43) Publication Journal Date : **1999.10.28**

(44) Accepted Journal Date : **2001.11.15**

(71) Applicant(s)
Mediscan GmbH

(72) Inventor(s)
Hans-Peter Bierbaumer

(74) Agent/Attorney
F B RICE and CO,605 Darling Street,BALMAIN NSW 2041

22585/99



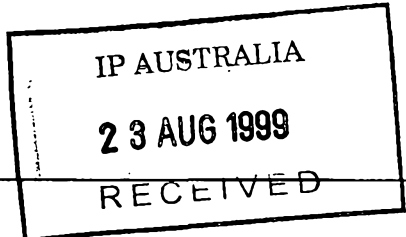
PCT
 WELTORGANISATION FÜR GEISTIGES EIGENTUM
 Internationales Büro
 INTERNATIONALE ANMELDUNG VERÖFFENTLICHT NACH DEM VERTRAG ÜBER DIE
 INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT)

| | | |
|---|-----------|--|
| <p>(51) Internationale Patentklassifikation ⁶ : A61L 2/00</p> | <p>A2</p> | <p>(11) Internationale Veröffentlichungsnummer: WO 99/39751 (43) Internationales Veröffentlichungsdatum: 12. August 1999 (12.08.99)</p> |
|---|-----------|--|

(21) Internationales Aktenzeichen: PCT/AT99/00031
 (22) Internationales Anmeldedatum: 4. Februar 1999 (04.02.99)
 (30) Prioritätsdaten:
 A 216/98 6. Februar 1998 (06.02.98) AT
 (71) Anmelder (für alle Bestimmungsstaaten ausser US): MEDIS-
 CAN GMBH [AT/AT]; Bad Haller Strasse 30, A-4550
 Kremsmünster (AT).
 (72) Erfinder; und
 (75) Erfinder/Anmelder (nur für US): BIERBAUMER, Hans-Peter
 [AT/AT]; Achleiten 67, A-4532 Rohr/Kremstal (AT).
 (74) Anwalt: SECKLEHNER, Günter; Pyhmstrasse 1, A-8940
 Liezen (AT).

(81) Bestimmungsstaaten: AL, AM, AT, AT (Gebrauchsmuster),
 AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ
 (Gebrauchsmuster), DE, DE (Gebrauchsmuster), DK, DK
 (Gebrauchsmuster), EE, EE (Gebrauchsmuster), ES, FI, FI
 (Gebrauchsmuster), GB, GD, GE, GH, GM, HR, HU, ID,
 IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS,
 LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL,
 PT, RO, RU, SD, SE, SG, SI, SK, SK (Gebrauchsmuster),
 SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW,
 ARIPO Patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW),
 eurasisches Patent (AM, AZ, BY, KG, KZ, MD, RU, TJ,
 TM), europäisches Patent (AT, BE, CH, CY, DE, DK, ES,
 FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI Patent
 (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE,
 SN, TD, TG).

Veröffentlicht
 Ohne internationalen Recherchenbericht und erneut zu
 veröffentlichen nach Erhalt des Berichts.

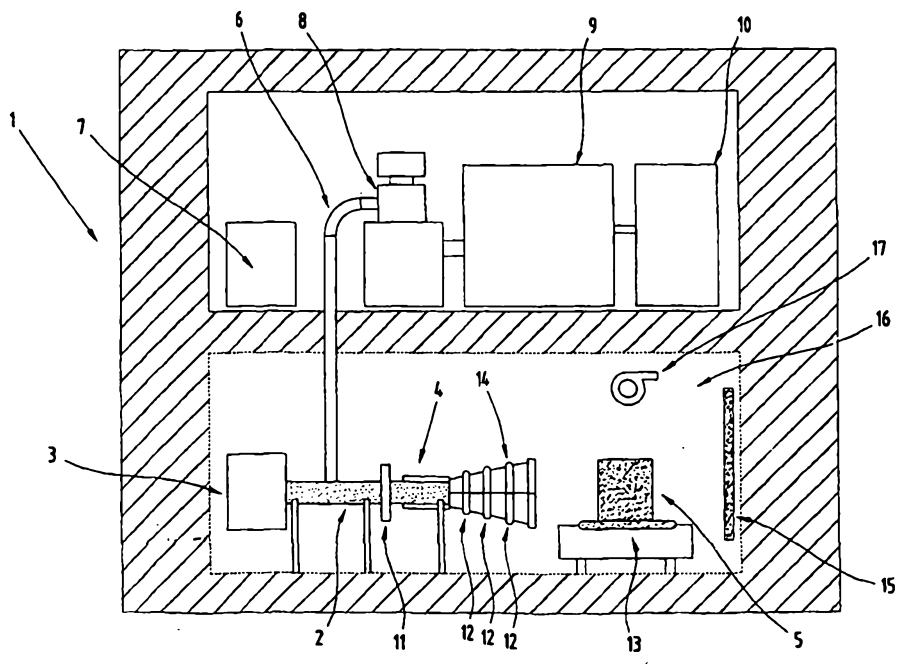


(54) Title: METHOD FOR TREATING AN ITEM

(54) Bezeichnung: VERFAHREN ZUM BEHANDELN EINES GUTES

(57) Abstract

The invention relates to a method for transforming the properties of an item (5), at least in a partial area, and/or for treating said item, especially a material, a waste product, a component, a food product, a liquid, a gas or the like. The item (5) is conveyed through at least one electron irradiation device, especially an electron accelerator, in an irradiation chamber (16) using a conveyor system (13). The electrodes emitted from a hot cathode (3) and needed for irradiation are focused and then pulsed with waves at a given predefined frequency in an acceleration unit. The electrons are emitted at a given frequency from the irradiation device and directed towards the item (5) to be irradiated,



Abstract

The invention relates to a method of altering the properties in at least a part-region of and/or treating an object (5), in particular a material, an item of waste, a component, a foodstuff, a liquid, a gas or similar. The object (5) is displaced by means of a conveyor system (13) past at least one electron-emitting device, in particular an electron accelerator, in an irradiation chamber (16). Electrons from an incandescent cathode (3) needed for irradiation purposes are focussed and pulsed in an accelerator unit with waves of a specific, pre-definable frequency, and are emitted from the irradiation device at a specific frequency and directed onto the object (5) to be irradiated.

Use Fig. 1 for abstract.



Method for treating an item

The invention relates to a method of altering the properties, at least in a part-region, of and/or for treating an item as defined by the characterising features of claim 1, and a system for altering the properties, at least in a part-region, of and/or for treating an item by irradiation as defined in
5 claim 40.

Processing products of the most varied of species by irradiation using the most varied of sources, e.g. γ or electron radiation, is a method which has become increasingly commonplace in recent
10 years. By using high-energy radiation, this method can also be used as a means of sterilising produce. However, in addition to flushing with toxins such as methyl bromide or ethylene oxide, irradiation to date has involved the use of radioactive isotopes such as cobalt 60 or caesium 137 primarily as a means of achieving an increase in quality. Although methods of this type are effective in killing microbes, bacteria and germs to a high degree, it must always be borne in mind
15 that the beam source is constantly activated and can not be "simply" switched off, so that the maintenance inspections required in these systems present a constant potential risk to maintenance personnel. Furthermore, irradiation techniques of this type are not without controversy, at least in the media world, making it very difficult to market produce treated in this way. Moreover, essential vitamins, minerals and nutrients are lost. An irradiation system of this type is
20 known from US 3,564, 241 A, for example. This document discloses a plant in which produce of all types is loaded in baskets mounted on overhead rails, in readiness for sterilisation. The baskets are fed on these rails into the interior of a radiation chamber, where they are irradiated from both the front and the rear with cobalt 60, depending on the selected layout of the guide rails.

25 In order to avoid the above problems, the irradiation method was improved so that heated cathodes were used as the beam source instead of radioactive material. The electrons emitted from the cathode are accelerated towards the anode and focussed, before being finally deflected on to the products to be sterilised. Practice has shown that the products can be sterilised to a degree comparable with that achieved using a radioactive irradiation process. A system of this type is
30 known from WO 94/22162 A. Apart from the nature of the beam source, this system is comparable with that disclosed in the above-mentioned US-A system in terms of structure. Here too, the produce is loaded into baskets guided on a rail and conveyed through the processing chamber. The disadvantage of using this system to convey the products is that, due to the selected con-



veyor system, specific parts of the conveyor baskets which are repeatedly subjected to constant irradiation have a higher tendency to wear.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is solely for the purpose of providing a context for the present invention. It is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed in Australia before the priority date of each claim of this application.

10 Summary of the Invention

In a first aspect, the present invention is a method of altering the properties, at least in a part region, of and/or treating objects, in particular a material, an item of waste, a component, a foodstuff, a liquid, a gas or similar, whereby the objects are displaced by means of a process conveyor alongside at least one electron-emitting device, in particular an electron accelerator, in an irradiation chamber, the electrons from an incandescent cathode needed for irradiation purposes being focused and pulsed in an accelerator unit with waves pulsed at a specific, pre-definable frequency and being emitted from the electron-emitting device at a specific frequency and directed onto the object to be irradiated, characterised in that the objects are transferred from a buffer conveyor to the process conveyor, the speed of the transfer being predetermined by a control system by means of an adjustable drive device so that objects already located on the process conveyor are not pushed and the objects are fed past the electron-emitting device without any intermediate spaces.

In a second aspect, the present invention is a system for changing the properties, at least in a part-region, of and/or for treating objects, in particular a material, an item of waste, a component, a foodstuff, a liquid, a gas or similar, having a conveyor system for the objects to be processed, having a process conveyor of a conveyor system for the objects to be treated, with a source for generating free electrons, an accelerator system for the free electrons, an irradiation chamber in which the objects are irradiated and which is surrounded by walls to protect against radiation, characterised in that the conveyor system is set up in such a way that, in order to improve the efficiency of the system, the objects to be irradiated are fed past the electron-emitting device from the accelerator unit without any spaces in between



them, a buffer conveyor with a drive device controlled by a control system being arranged before the process conveyor in the direction of displacement.

The underlying preferred feature of the present invention is to propose a method and a system for irradiating an objection, which enables objects to
 5 be treated and/or their properties to be altered at least in a part-region, by irradiation, in order to produce uniform exposure to electrons across as large a volume as possible.

The preferred feature achieved by the invention due to the characterising features of claim 1. The first advantage of using this type of
 10 method is that produce of the most varied of types, for example foodstuffs such as spices, water or similar, substances such as plastics, ceramics, metals or similar, can be irradiated in such a way that a significant improvement in quality is obtained. Another advantage is the fact that the electron radiation
 15 can be pulsed at a pre-definable frequency, which assists in distributing the dose uniformly in the object to be irradiated.

Another advantageous embodiment is defined in claim 2, enabling high-energy electrons to be accelerated in a simple manner.

The embodiment defined in claim 3 provides a capacity in which the electromagnetic waves generated can be propagated in the form of a stationary wave.

20 Claims 4 and 5 outline advantageous embodiments whereby a simple and safe operating technology can be used to accelerate the electrons on the one hand and amplify the effect of acceleration on the other.

Claim 6 defines an advantageous embodiment designed to further enhance the uniformity of the dose distributed in the object to be irradiated.

25 Also of advantage is an embodiment defined in claim 7, since it provides electrons with an energy which further enhances safety whilst producing the desired effect in the object to be irradiated.

The embodiments defined in claims 8 and 9 advantageously allows the required radiation dose to



be adapted to the object to be irradiated and does so specifically on the basis of its dimensions.

A radiation system defined in claim 10 and/or 11 is advantageous since irradiation of the objects does not have any adverse effects on the parts of the system used to irradiate the objects.

5

En embodiment defined in claim 12 advantageously shortens the irradiation process, thereby achieving a higher turnaround of the objects.

10

Due to the embodiments outlined in claims 13 and/or 14, it is advantageously possible to adapt the dose administered to suit the respective properties of the objects to be irradiated whilst operating at a high production rate.

15

With the variant of the method defined in claim 15, the dose administered during irradiation can be radio-chromatically stored for subsequent evaluation and this data can be accessed later for control purposes.

The advantageous embodiments defined in claims 16 and 17 enable the irradiation process to be automated to a high degree.

20

Also of advantage is an embodiment outlined in claim 18 since it provides an additional control and monitoring routine.

The advantage of the embodiment defined in claim 19 is that the method can be universally applied to objects of the most varied nature.

25

In accordance with an embodiment outlined in claim 20, simple means enable the objects to be irradiated individually so that the irradiation process can be finished off in a simple manner at a later stage.

30

The advantage of the embodiment defined in claim 21 is that a dosimeter used to control the radiation dose administered can be specifically assigned to the object to which the dosimeter was attached, thereby ensuring a high degree of safety.



Productivity can be increased by means of the advantageous embodiments outlined in claims 22 and 23.

5 The embodiment described in claim 24 advantageously improves the capacity utilisation of the accelerator unit.

The embodiment defined in claim 25 advantageously delivers the objects to the accelerator chamber depending on the degree to which they have already been processed.

10 The embodiment outlined in claim 26 has an advantage because it increases the degree of automation in the production process still further.

Other embodiments described in claims 27 and 28 allow an object to be irradiated several times, which means that the operating parameters of the accelerator unit can be retained at a high level,
15 enabling it to be run without interruption for a long period.

The embodiment defined in claim 29 provides simple means of monitoring the objects as they are fed in and out.

20 The embodiment defined in claim 30 provides a simple means of allowing the irradiation process to be integrated in the production line of a manufacturing process for objects.

With the embodiment outlined in claim 31, when the objects have been irradiated, they can be fed away to a despatch area.

25 The embodiment outlined in claim 32 provides an effective means of defining the dose administered to the object.

30 The advantage of the embodiment described in claim 33 is that the minimum radiation dose to be applied can be directed across significant points in or on the object so that the parameters used in the production process itself can be selected to ensure that the object is best prepared for the irradiation process.



Also of advantage is an embodiment defined in claim 34, whereby the process parameters can be set, regulated and controlled depending on the radiation dose to be administered.

5 Claim 35 defines an advantageous embodiment whereby a means is provided which allows a repeated check to be made on the stability of the radiation process.

With the embodiment outlined in claim 36, the stability of the radiation process can be controlled individually and randomly.

10 The embodiment of the method described in claim 37 is of practical advantage because the radiation process can be checked at a glance by means of a display on a screen, for example.

The advantage of the embodiments described in claims 38 and/or 39 is that the process parameters can be automatically optimised and adapted to the respective object to be treated.

15

The task set by the invention is also solved by the features set out in claim 40. These offer advantages because the limit on the specific maximum size of the object is considerably higher than is the case with conventional systems and in addition, the electron flow does not go to waste due to intermediate spaces between the individual objects, nor does the electron flow have to be interrupted.

20

The advantage of another embodiment defined in claim 41 is that special precautions usually needed for the infeed and outfeed, such as gating systems, can be dispensed with.

25 Claim 42 offers a cost-effective variant of a system as proposed by the invention.

By using the embodiment defined in claim 43, a system of the type proposed by the invention can be readily integrated in an overall plant for a production process. Furthermore, this embodiment also offers a simple means of providing facilities to ensure that the finished goods are despatched quickly and safely, by means of a truck, for example.

30

Another embodiment, defined in claim 44 is of advantage because the objects to be irradiated can be fed past the accelerator unit at a pre-definable angle, as a result of which the dose applied to



the objects is unlikely to be unevenly distributed.

With an embodiment as defined in claims 45 and 46, contamination of the irradiated goods can advantageously be largely ruled out.

5

A high degree of safety can be guaranteed for the personnel operating the plant if using the embodiments described in claims 47 to 49.

10

The embodiment defined in claim 50 also has advantages since it is possible to dimension the system proposed by the invention to meet the essential requirements of the conveyor system.

By virtue of another embodiment defined in claim 51, electrons can be accelerated to a high speed by simple means, thereby ensuring an adequate deposit of high-energy electrons.

15

With the embodiments outlined in claims 52 and 53, the electron beam is able to cover a large part of the surface area of the objects to be irradiated.

20

By dint of the embodiment described in claim 54, the objects to be irradiated can be processed from start to finish in a single pass. At the same time, this type of electron-emitting device can be used to accelerate the electrons.

The advantageous embodiment set out in claim 55 obviates the need for any awkward handling of the goods, in particular unpacking and re-packing.

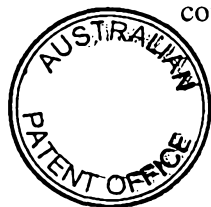
25

Also of advantage is the embodiment defined in claim 56, since it allows larger objects to be irradiated without any detriment to the irradiation quality.

30

The embodiments outlined in claims 57 and 58 offer an advantage in that an electron beam can be provided whose energy and output reliably ensure that the desired effect is produced in the irradiated object.

The advantage of the embodiments defined in claims 59 and 60 is that there is no need for a complicated system to move the objects to be irradiated.



Advantageously, the embodiments set out in claims 61 and 62 ensure that the radiation dose is uniformly distributed.

5 By accelerating the electrons with electromagnetic waves as described in claim 63, a high energy level can be imparted.

The advantage of the embodiments defined in claims 64 and 65 is that in order to produce electromagnetic waves to accelerate the electrons, a capacity is provided in which stationary waves can be propagated.

10

The embodiments defined in claims 66 to 67 offer advantages because the energy imparted to the electrons is so high that under-irradiation of the objects is virtually out of the question.

15 The embodiment defined in claim 68 ensures that moving system components are handled so as to be subjected to the least damage possible.

The advantage of the embodiments outlined in claims 69 to 72 is the high product turnaround and hence shorter production time.

20 Also of advantage is another embodiment described in claim 73, whereby the object to be irradiated can be passed across the electron-emitting device again in such a way that double exposure of individual surfaces of the object can be ruled out.

25 In accordance with the embodiments outlined in claims 74 and 75, the dose applied to the object is largely guaranteed to remain uniform if constant operating parameters are set for the accelerator unit.

Claim 76 proposes an embodiment whereby the conveyor system can be assembled using inexpensive and low maintenance individual components.

30

By splitting the overall conveyor system up into individual parts, as described in claim 77, an advantage is to be had since these parts can be set up depending on the respective beam load from the electron accelerator.



Claims 78 to 80 describe advantageous embodiments whereby the objects can be individually handled, thereby providing an effective quality management system.

5 The embodiments described in claims 81 and 82 advantageously enable the individuality of the objects to be detected automatically.

In accordance with the embodiments proposed in claims 83 and 84, any interruption in the flow of goods due to fluctuations in the input region can be ruled out as far as possible.

10 The embodiment set out in claim 85 has proved to be of advantage because by using an operating device of this type for a stop, a low-maintenance system can be provided which is stable in operation over long periods.

15 The embodiment described in claim 86 offers the advantageous and simple possibility of smooth operation of the conveyor system and the respective forward feed speeds required can be finely tuned to suit the properties of the object to be irradiated.

20 In accordance with the embodiments described in claims 87 and 88, an advantage is obtained because the degree of treatment which needs to be applied to the goods can be determined in a simple manner and the efficiency of the entire system improved accordingly.

By providing an Emergency-Stop switch in the region of the conveyor system as defined in claim 89, the safety of the plant can be further enhanced in the event of faults.

25 Claim 90 provides an advantageous embodiment whereby the objects to be irradiated are transported more safely by means of the conveyor system.

By using a wire mesh belt for the process conveyor, as with the embodiment outlined in claim 91, the operating safety of the process conveyor can be increased.

30 Another embodiment such as that described in claim 92 is possible, whereby the environment can be protected by improving the primary resources to generate heat.



Finally, the embodiment outlined in claim 93 is of advantage because the atmospheric conditions inside the system are maintained so as to be compatible with human presence.

5 The invention will be described in more detail below with reference to the embodiments illustrated in the drawings.

Of these:

10 Fig. 1 is a block diagram showing the basic modules used for a system as proposed by the invention;

Fig. 2 is a system as proposed by the invention, seen from a plan view;

15 Fig. 3 shows the dose distribution in irradiated objects depending on the penetration depth;

Fig. 4 illustrates another embodiment of the system proposed by the invention, in a plan view;

20 Fig. 5 illustrates an embodiment of the electron-emitting device;

Fig. 6 is a simplified illustration of an embodiment of a part of the conveyor system, seen from a side view;

25 Fig. 7 is another simplified illustration of an embodiment of the process conveyor, seen from a plan view;

30 Fig. 8a-8e provide a schematic illustration of the timing with which the objects are conveyed in the region of the transverse conveyor in order to irradiate the objects from several sides.

Firstly, it should be pointed out that in the different embodiments described, the same parts are shown by the same reference numbers and referred to by the same component names and the disclosures made throughout the description can be transposed in terms of meaning to components



bearing the same reference numbers or the same component names. Similarly, the description of positions chosen in the description, e.g. top, bottom, side, etc. relate directly to the drawing being described and can be transposed in terms of meaning when a different position is being described. Furthermore, the individual features or combinations of features from the different em-
5 bodiments described and illustrated may be regarded as independent, inventive solutions or solutions of the invention in their own right.

Fig. 1 is a schematic block diagram showing the basic modules contained in a system 1 of the type proposed by the invention. In a linear accelerator 2, electrons are released from a heated incandescent cathode 3, which are then accelerated across the length of the linear accelerator and
10 focused by means of quadrupole magnets 4. Instead of the linear accelerator 2, it would, of course, also be possible to use all other types of accelerators, such as ring accelerators for example.

15 The system 1 proposed by the invention preferably has a beam output of between 5 kW and 30 kW, in particular 15 kW.

The energy of the electrons required to alter the properties of objects 5, for example to sterilise them, is preferably between 5 MeV and 30 MeV, in particular 10 MeV. Due to the fact that it is
20 not possible to use an acceleration system with electrostatic fields such as conventionally used in cathode ray tubes, for example, with an energy of ca. 30 kV because of these high energy levels, it is preferable if the electrons are accelerated by means of electromagnetic waves.

Cavity resonators 6 may be used, for example, known as wave guides, to generate these electro-
25 magnetic waves along the acceleration path. Inside these cavity resonators 6, which may be made from metals such as copper, alloys thereof such as bronze and brass, or from steel, ceramic, plastics or similar, a stationary wave is formed, whose field distribution is determined by the geometry of the cavity resonators 6 and the frequency of the microwave energy fed in.

30 The stationary wave in the accelerator unit is preferably excited by pulsed microwaves, which are generated by an oscillator 7, for example, with an RF-driver, and amplified by a microwave amplifier 8, for example a klystron. The energy required for this purpose is supplied by a high-voltage modulator 9, which is supplied from a primary energy source 10, for example the public



power grid.

The frequency of the pulsed microwaves lies within the GHz range, whilst the electrons emitted by the linear accelerator 2 may have a pulse frequency of approximately 300 pulses per second.

5

Accelerated and focused in this manner, the electrons are applied to the objects 5, provided a shutter 11 is open, in a defined, predetermined path, assisted by deflector magnets 12. As will be explained in more detail below, the objects 5 are moved with the aid of a conveyor system 13 past an electron-emitting device 14, for example a scan horn, from which the electron beam is

10

emitted via a window made from a metal film, for example. The dimensions of the electron-emitting device 14 are preferably selected so that a scan height of up to 100 cm, preferably 60 cm, can be achieved. Accordingly, the electron beam will strike objects 5 up to the selected scanning height. For large, in particular bulky objects, whose height falls outside this range, the dimensions of a system 1 proposed by the invention can be adapted to suit requirements accord-

15

ingly. In order to achieve the requisite dimensions, the height of the electron-emitting device 14, in particular, can be adjusted as well as the units co-operating with the electron-emitting device 14 which deflect the electron beam, for example electric coils. For safety reasons, a beam stop 15, for example an aluminium plate, may be provided behind the objects 5 in the emission direction of the linear accelerator 2, preferably mounted on a boundary of an irradiating chamber 16,

20

so that electrons potentially passing through can be decelerated, thereby giving rise to soft γ -radiation only. Since humans need to be able to enter the irradiation chamber 16 for maintenance purposes, at least one venting device 17, for example a ventilator, may be provided in order to maintain a compatible atmosphere in the irradiation chamber 16.

25

At this stage, it should be pointed out that any other methods known from the prior art could be used to accelerate the electrons. Above all, the embodiment of a system 1 proposed by the invention is not restricted to the use of microwaves as an accelerating medium which is also amplified by a klystron.

30

Fig. 2 is a simple, schematic illustration of the system proposed by the invention, seen from a plant view. The linear accelerator 2 is located in the irradiation chamber 16, which is surrounded by walls 18 to 22. The walls 18 to 22 are preferably designed so that they prevent any electrons from escaping and, since this is ionising radiation, any reaction products in the atmosphere of the



irradiation chamber 16, for example ozone. By preference, the walls 18 to 22 as well as a floor plate 23 and the cover plate, not illustrated in Fig. 2, forming the bottom and top seal of the irradiation chamber 16, are made from steel-reinforced concrete. However it would also be conceivable to use other materials capable of fulfilling the requirements listed above, e.g. walls with
5 cladding made from metals with a high electron catchment cross section. The thickness of these walls 18 to 22 will depend on the respective regulations in force in the country governing protection against irradiation, but in any case should be such that they will guarantee the safety of the system 1. By preference, the wall 20 will be four metres thick and the walls 19 and 21 will each be three metres thick. The walls 18 and 22 may be of a thinner design although they should make
10 up three metres in total. The wall 20 is thicker than the other walls 18, 19, 21, 22 due to the fact that the electron beam emitted from the linear accelerator 2 is directed onto this wall 20.

As may be seen from Fig. 2, the objects 5 to be treated are delivered to and fed back out of the irradiation chamber 16 by the conveyor system 13 via a labyrinthine entrance. Designing the entrance to the irradiation chamber 16 in this manner has an advantage in that no additional facilities have to be provided for transporting the objects 5 in and out, for example special gating systems, since any ionising radiation and reaction products of the above-mentioned type are prevented from escaping as far as possible. Although, in theory, it will still be possible to measure a specific residual dose, this will be kept within the permissible legal limits due to the selected design of the screening system. In addition, the atmosphere is not dangerous to a human because of
15 the venting device 17 (not illustrated in Fig. 2) mentioned above.
20

Fig. 2 also illustrates the preferred embodiment of the conveyor system 13. It is preferably made up of continuous conveyors, e.g. a roller track, a bar conveyor, a chain conveyor, a chute, a belt
25 conveyor or similar, and is used to transport objects 5 of differing sizes. By preference, the conveyor system 13 is divided up into a feed track, a delivery track, a process track, a buffer roller conveyor, a rising conveyor, at least one transverse conveyor, at least one corner-turning mechanism, a discharge track and the relevant equipment. However, it would also be conceivable to use different conveyor systems, at least for parts of the conveyor system 13, such as belt conveyors,
30 vibrating conveyors or similar. The conveyor system 13 may preferably comprise two separate regions, one of which will be an unclean feed region 24 separated by a barrier device 25, such as a grating, a dividing wall, etc., from a clean discharge region 26.



The objects 5 may be transferred manually from transport containers 27, such as pallets, to a feed track 28, for example, on which a control console 29 with an Emergency-Off switch 30 is placed. In the region of the driven feed track 28, the objects 5 may be fed alongside a marker device 31, such as a label dispenser, a device for attaching microchips, an ink jet printer or similar, for example, so that they can be simultaneously identified. So that the objects 5 can be identified and the detected data forwarded to an EDP system, where it will preferably be processed, a scanner 32, for example a reading head, is mounted on the feed track 28 before a stop 33. If microchips are used to tag the objects, it is also possible to fit them with a transmitter, for example an IR transmitter, from which data specific to the object can be transferred to a receiver unit, which is preferably mounted in the region of the conveyor system 13.

From the roller track of the feed track 28 and the stop 33, the objects 5 are transferred to a delivery track 34, which is preferably also a roller track. The delivery track 34 conveys the objects 5 into the irradiation chamber 16. A stop 33 may be mounted on the delivery track 34 before every change of direction in the conveyor system. The stop 33 will preferably be provided in the form of a valve coil, two reed switches and a driver roller. Clearly, it would also be conceivable to use other embodiments, such as light sensors, mechanical switches, magnetic pulse transmitters or similar.

From the roller track of the delivery track 34, the objects are transferred to the irradiation chamber 16 on a conveyor 35, which is preferably designed as a chain conveyor. If opting for a chain conveyor, account will need to be taken of the fact that the conveyor system 13 overall should be maintenance-free for as long as possible, particularly as regards ionising radiation.

At the corners of the irradiation chamber 16, the objects are fed along by means of corner units, which are also preferably chain conveyors. Once the centre of gravity of the objects 5 has been pushed across the centre point of the roller, the object 5 is transferred onto a transverse conveyor 36 on a slightly lower level, for example a transverse chain belt conveyor, the speed of which is preferably faster than that of the conveyor 35. During this process, the object is rotated by more or less 90° around a corner stop (not illustrated in Fig. 2) and is simultaneously oriented at the inner side boundary of the chain guide, for example a stop made from metal, plastics or similar. The object 5, i.e. the surfaces to be irradiated, is oriented so that it can be fed past the electron beam at a defined angle relative to the electron-emitting device 14, preferably 90°. Clearly, how-



ever, it would also be possible to feed the objects 5 in any position relative to the electron-emitting device 14, e.g. at an angle, transversely, upright, etc..

5 Since all the techniques used to turn corners on conveyors require a large distance between the items being conveyed, thereby preventing the system 1 from being used to its optimum efficiency, the objects 5 are transferred from the transverse conveyor 36 onto a buffer conveyor 37 in order to keep the distance between objects 5 as small as possible, thereby enabling the electron accelerator to be operated economically. The buffer conveyor 37 preferably consists of freely rotating rollers, which are mounted on a chain at either end. The objects 5 are then preferably fed
10 onto a process conveyor 38 without any gaps in between, which is preferably a wire mesh belt and on which the objects 5 are fed past the electron-emitting device 14 of the linear accelerator 2. The speed at which the objects 5 are transferred can be determined by means of adjustable drive devices, e.g. motors, from the control system so that as the gaps close between the objects 5, the objects 5 which are already on the process conveyor 38 are not pushed.

15 Once the objects 5 have been irradiated, they are fed by means of a conveyor 39, e.g. a chain conveyor, to a rising conveyor 40, which is also a chain conveyor, for example, from where they are preferably conveyed across a driven roller track 41, preferably arranged above the delivery track 34, out of the irradiation chamber 16.

20 In the delivery region, the objects 5 are preferably fed along on two levels, it being possible for the objects 5 to be optionally fed in and out both in the top and in the bottom level. If necessary, however, these two parts of the conveyor system 13 may be fed alongside one another, in order to be able to transport larger objects 5. This dual-level system has an advantage in that the size of
25 the labyrinthine entrance to the irradiation chamber 16 can be kept relatively small, thereby increasing the safety of the system 1.

A counting station, for example a scanner 32, may be positioned in the region of the roller track 41, by means of which the degree to which the objects 5 have been processed can be detected. By
30 preference, three sensors co-operate with the counting station. Located after the scanner 32 is another stop 33 ahead of a transverse conveyor 42. Using this transverse conveyor 42, the objects 5 can be transferred back to the feed track 28, preferably being rotated by 180° in the process, to be fed back through the irradiation process.



So as to be able to ascertain at any one time how many objects 5 on the conveyor system 13 have not been treated or have been treated on one side only, two additional counting stations, each with three sensors, are preferably installed adjacent to the counting station ahead of the transverse conveyor 42, to carry out reciprocal checks. By preference, an additional counting station is provided in the vicinity of the electron-emitting device 14 and another counting station on the feed track 28 in the region of the control console 29.

A discharge track 43 forms the end of the conveyor system 13 at which the objects are removed from the processing area. An Emergency-Stop switch 30 may also be mounted in the region of the discharge track 43 for safety reasons.

The objects may be picked up from the discharge track 43 in the discharge region 26 manually and transferred onto a transport container 27, for example a pallet. If necessary, the loaded container units 27 ready for despatch can be shrink-wrapped in a winder.

The individual parts of the conveyor system 13 are preferably driven by servo motors. However, they could also be driven by any other appropriate drive mechanisms known from the state of the art. In any event, a drive device 44 of the transport system 13 should be such that the object 5 can be moved through the electron beam at a specific, defined speed. Preferably, feed rates in the range of 1 mm/s to 400 mm/s, preferably 5mm/s to 200 mm/s are used, the displacement speed being set to suit the dose of radiation to be administered. The number of drive devices 44 used will preferably be selected on the basis of the length and the number of individual conveyors.

The object 5 is preferably irradiated (as may be seen from Fig. 2) horizontally, perpendicular to the direction in which the object 5 is conveyed. However, it would also be possible for the object 5 to be irradiated from all other directions, for example from above, from underneath, etc., so that the object 5 can be simultaneously and alternately irradiated from several sides. If only one electron accelerator is used, it would also be conceivable to split the electron beam in front of the outlet of the electron-emitting device 14 into at least two parts, by means of deflector magnets for example, one part-beam being alternately directed onto the object 5 other than from the main direction of irradiation, for example from above. In this situation, the use of a wire mesh belt has proved to be a particularly effective process conveyor 38 since, as a rule, it can be used for long periods without problems, even if subjected to increased radiation from above.



Depending on the acceleration method used, a pulsed electron beam may be used to cover the surface of the object 5. This being the case, it has been found to be particularly advantageous if there is at least a 50% overlap of the pulses, which produces a uniform distribution of the dose in the object 5. Clearly, the speed at which the conveyor system 7 is fed, particularly the process
5 conveyor 38, will need to be adjusted to the dose to be administered and to the frequency timing of the electron beam.

The maximum possible forward speed of the process conveyor 38 is determined in particular by the pulse rate, the pulse duration, the scanning frequency and the number of pulses.

10

If the system 1 proposed by the invention is used to scan the objects 5, it has proved to be of particular advantage compared with the systems known from the prior art if the objects 5 are fed past the electron-emitting device 14, for example the scan horn, without any intermediate spaces. This increases the efficiency of the system 1 significantly because, compared with conventional
15 systems, the electron beam is constantly directed at the surface of an object 5 to be irradiated. To increase the efficiency of the system 1 still further, a sensor may be provided in the region of the process conveyor 38, for example an optical sensor, which detects the end of or an interruption in a flow of objects and passes this information on to a control device for the electron beam accelerator so that it can adjust the operating parameters of the accelerator unit and the accelerator unit
20 can be switched to stand-by mode only.

The purpose of the shutter 11 is primarily to serve as a protective device for the sensitive internal parts of the electron accelerator so that in the event of breakage or damage to the electron outlet window in the region of the electron-emitting device 14, said parts of the electron accelerator can
25 be protected from potential damage.

In order to increase the operating safety of the system 1 proposed by the invention still further, another protective device 45 may be provided where the conveyor system 13 enters the irradiation chamber 16, which might take the form of a dividing wall, an appropriate grating arrangement or similar, for example, with a door 46 mounted therein. This will largely prevent unau-
30 thorised access to the irradiation chamber 16. Additional measures might also be taken and an electronic lock system could be provided on a door 46 mounted in the protective device, for example, to prevent access to the irradiation chamber 16 if the electron-emitting device 14 is emit-



ting electrons at that point in time. By preference, an Emergency-Stop switch 30 can be provided on the door 46.

5 However, it would also be possible to set up the control system of the accelerator unit so that an appropriate sensor, for example an electrical contact, an optical sensor or similar, in the frame of the door 46 of the linear accelerator 2 could be automatically interrupted when the door 46 is opened, thereby ruling out virtually 100% any potential risk to persons due to electron emissions. As an additional safety feature, a cable pull switch 47 can be provided along the conveyor system 13, for example. This would enable personnel who had inadvertently entered the irradiation chamber 16 when the accelerator unit was activated to halt the irradiation process and, provided the control and drive unit were set up accordingly for the accelerator unit, to indicate to the control and drive device unit via the cable pull switch 47, by sounding an optional acoustic warning signal, that the electron accelerator should not be switched to operating mode. In addition, it would also be possible to provide electrical contacts, for example, in a door mat behind 15 the door 46 or in the labyrinthine entrance in order to detect when persons are entering the irradiation chamber 16 whilst the accelerator unit is in operation. This will naturally mean that the dimensions of the door mat must be selected so that it will not be possible to step over it.

Clearly, light sensor units could also be mounted at specific points around the system 1, for example in the vicinity of the door 46, in order to monitor access to the irradiation chamber 16. 20

Other standard sensors and warning devices such as motion sensors, rotating mirrors, alarm horns, could, of course, also be positioned at any point in the system 1.

25 It has also proved to be particularly effective if, as mentioned above, observation cameras 48 are placed at nodal points around the system 1, by means of which the irradiation chamber 16 as well the individual parts of the labyrinthine access system and the conveyor system 13 can be monitored.

30 All the data, in particular the data picked up by sensors, can advantageously be transmitted by optical fibres, thereby avoiding any interference from the accelerator unit during data transmission.



As an additional protective measure in the region of the beam path of the linear accelerator 2, a beam interrupter may be provided, which will automatically cut in in the event of any operating faults in the system 1, so that electrons can not be discharged from the linear accelerator 2, in particular the electron-emitting device 14.

5

By preference, the heat built up during processing is recycled in a manner known from the prior art by means of an appropriate heat exchanger and fed back into the process system.

Fig. 3 illustrates the reach distribution, plotted from experimental data, the penetration depth in the object 5 to be irradiated being plotted in centimetres on the x-axis and the dose transferred being plotted in KGy on the y-axis. In order to plot this curve, a test product with a density of 0.1 g/cm^3 was used. This was irradiated with electrons having an energy of 10 MeV and a beam output of 15 kW.

15 The electrons penetrate the objects 5 to be irradiated, which may be packaged under certain circumstances, and start to alter the substance to be irradiated after only a few centimetres. This is determined not least by the high active cross section of the electrons and a density of approximately 1 g/cm^3 of the objects 5 to be irradiated. For this reason, it is usually necessary to apply radiation to the objects 5 from both sides. The conveyor system 13 is therefore designed so that
20 objects 5 which have already been treated can be fed back through the irradiation process, preferably rotated by 180° .

Typical medical products generally have a density of 0.05 g/cm^3 to 0.3 g/cm^3 and may therefore be treated in their original packaging.

25

As may be seen from Fig. 3, the dose applied to the irradiated test product of said density travels up to a distance of approximately 30 cm and the distance across the product is more or less irrelevant. With the selected parameters, objects 5 of a thickness up to 60 cm can be irradiated from both sides without any loss of quality. The thickness of the product is therefore correlated
30 with the flow line of the linear accelerator 2. In order to irradiate objects 5 of larger dimensions, the parameter settings can be adjusted accordingly.

Fig. 4 is a schematic diagram of another embodiment of a system 1 as proposed by the invention,



seen in a plan view. The individual components of this embodiment are essentially the same as those of the embodiment described above. The only difference is that separate labyrinths are used to feed the objects 5 in and out. As a result, the unclean feed region 24 is separated from the discharge region 26 by the irradiation chamber 16. Consequently, this system 1 can be readily integrated in a manufacturing process for objects 5, particularly as regards the design of the conveyor system 13, and the semi-finished objects 5 can be fully automatically delivered to the feed region 24 (not illustrated in Fig. 4), passed through the irradiation process and discharged from the opposite end in the discharge region 26. Clearly, in the embodiment described, it will only be possible to feed through objects 5 whose dimensions and thickness are such that only one irradiation pass is required in order to produce the desired effect.

However, if this is not the case, it is nevertheless still possible, as illustrated in the top part of Fig. 4, to transfer the objects 5 via a transverse conveyor 42 after the first pass through the irradiation process and onto a return conveyor 49. Due to the fact that none of its components are exposed to radiation at any time, the return conveyor 49 may be made from simple and inexpensive materials, for example an endless rubber belt. If there are several changes of direction in the return conveyor 49, as is the case in the diagram of Fig. 4, it may be divided up accordingly using elements known from the prior art, for example corner-turning devices, roller conveyors with a 90° turn or similar.

As may be seen from the right-hand part of Fig. 4, the objects 5 fed back are again transferred via a transverse conveyor 42 of the delivery track 34 of the conveyor system 13 and passed through the irradiation process again.

Clearly, instead of providing an additional transverse conveyor 42 in the left-hand part of Fig. 4, it would also be possible to feed the objects 5 back round to the return conveyor 49 by means of an additional corner-turning device 50 (shown by broken lines in Fig. 4). In this case, the clean discharge region 26 is on the same side of the irradiation chamber 16 as the unclean feed region 24. This being the case, the unclean region can be separated from the clean region by means of the barrier device 25 mentioned above.

Fig. 5 is a schematic illustration of a different embodiment of an electron-emitting device 14. Instead of the scan horn mounted at the front end of the linear accelerator 2, it essentially consists



of a ring 51 with several deflector devices 52 mounted around its periphery, for example coils, magnets or similar. As a result, the electrons located on a peripheral track inside the ring 51 are emitted through windows 53, for example a metal film, positioned opposite the deflector devices 52, and can then penetrate the objects 5. The object 5 to be irradiated is conveyed through the
5 ring 51 by the conveyor system 13. Beam stops 15 are mounted outside the ring 51 above the deflector devices 52 in such a way that any electrons passing through the oppositely lying windows will be captured.

Using this embodiment of an electron-emitting device 14, any number of deflector devices 52,
10 windows 53 and beam stops 15 may be provided around the periphery of the ring 51. However, care must be taken to ensure that the linear accelerator is itself not exposed to irradiation due to ill-considered positioning of the windows 53.

Advantageously, with a system 1 of the type proposed by the invention, objects of the most varied
15 type can be treated and their properties altered in part-regions. A whole variety of products may be sterilised. These might include, amongst others, OP equipment, OP cladding, bonding substances, OP waste, pharmaceutical raw materials, pharmaceutical packaging, containers made from plastics and/or glass, test containers and laboratory equipment for the biotechnology sector, the sterilisation of liquids, recycled materials and refuse in the environmental technology sector,
20 the removal of germs from plastics, the sterilisation of and removal of germs from spices, raw materials, products, beverages, seals and the sterilisation of packaging, containers or receptacles in packaging technology.

However, apart from sterilisation, there is a whole range of possible applications for a system 1
25 of the type proposed by the invention. These might include the treatment of surfaces, for example by curing, curing and cross-linking plastics, setting and cross-linking varnishes. By selecting an appropriate transport system, for example in the form of bottles, even liquids, e.g. beer, water or similar, and gases can be irradiated in this manner. Bulk commodities and granulates of the most varied type can also be irradiated using the system 1 proposed by the invention.

30

Fig. 6 illustrates a different embodiment of a conveyor system 13, which also offers the option of irradiating long items in the system 1 proposed by the invention. Given that it is especially difficult to rotate long objects by a 90° turn in regions where space is tight, the embodiment illus-



trated in Fig. 6 allows long objects to be ce only restrict at. The only restriction in terms of the length of the objects 5 will be the height or radiation cha and irradiation chamber. As most parts of the conveyor system 13 are essentially ith the embodime se of the embodiments described above, only those parts that are different will be d

5

Because of the restriction of the radiation ldue to the ele ight) due to the electron-emitting device 14 (not illustrated in Fig. 6), for example ts 5, which are objects 5, which are fed through the irradiation chamber standing upright, for exare brought to aets, are brought to a position in front of the electron-emitting device 14 in which th of the object e area of the object 5 can be covered.

10

As a result, as illustrated in the left-hand pct 54 can be j contact 54 can be provided on the process conveyor 38 on the intake side of the cfor example a n 13, for example an electrical contact, which reacts to pressure and is linked via aator 56, for e in actuator 56, for example a lever made from metal, plastics or similar. The contact so as to prep ipped so as to prepare the object 5, for example by applying a foam coating.

15

As the object 5 is fed by the conveyor 39 t when pressu 4 and when pressure is applied thereto, an electric signal is transmitted across the or 56 so that t actuator 56 so that the actuator 56, which is mounted so as to rotate at a point 57, is n the direction ards in the direction of arrow 58 so that the object 5 is guided in a rotary movemerow 59. As a r by arrow 59. As a result, the object 5

20

will be moved from an upright position ona position lyin 39 to a position lying flat on the process conveyor 38. In this laid flat position, the oast the electro f fed past the electron-emitting device 14 (not illustrated in Fig. 6) and its surface dilelectron-emitti the electron-emitting device 14 is simultaneously exposed to the electron beam n tipped from i is then tipped from the processor conveyor 38, which is preferably arranged on the conveyor onto the conveyor 39 at a tipping point

25

60 as soon as the centre of gravity of the oeyond the tipj ved beyond the tipping point 60. When an end face 61 of the object 5 comes into c2 of an actual stop 62 of an actuator 63, which can be rotatably mounted at a point 64, the object as the proces igned as the process conveyor 38 moves forward and returned to an upright positioi can be transj object 5 can be transported back out of the irradiation chamber standing upright againtomatically re 63 automatically returns to its initial

30

position as soon as the stop 62 is released erably, the lat . Preferably, the latter is spring-mounted.

In order to guarantee the lateral stability of the device 65 a guide device 65 can be mounted along



the entire length of the conveyor system 13. By preference, this will consist of two height- and width-adjustable rails enabling objects 5 of different widths and heights to be conveyed through the irradiation chamber.

- 5 Various measures known from the state of the art may be used to prevent long objects from tipping over in a direction parallel with the conveyor 39 if the standing surface is too small.

Clearly, it would also be possible to arrange the process conveyor 38 on a lower level than the conveyor 39, although this would have the disadvantage of an additional height restriction. This
10 being the case, the actuators 56, 63 would have to be adapted accordingly. In particular, the actuator 63 would have to be positioned at the start of the process conveyor 38 (in the left-hand part of Fig. 6) in order to be able to place long objects into an upright position as they slide off. The actuator 56, which is then placed at the end of the process conveyor, can then assume charge of transferring the long objects to the next conveyor 39 after irradiation.

15

The conveyor 39 and the process conveyor 38 may be designed as continuous conveyors, as mentioned above.

Fig. 7 is a schematic illustration of a conveyor system 13, seen from a plan view, by means of
20 which the objects 5 can be irradiated from several sides during a single circuit. To this end, the process conveyor 38 to which the objects 5 are delivered by the conveyor 39, is interrupted by a rotary device 66. This rotary device 66 is preferably positioned before the electron-emitting device 14 of the accelerator unit. As objects 5 are carried from the process conveyor 38 on to the rotary device 66, which may be a turn-table, the latter may be detected by an observation device
25 67 for example, which might be provided in the form of a sensor. The conveyance process will then be interrupted, causing the rotary device 66 to be rotated, preferably by 180° to 360° . A sensor, not illustrated in Fig. 7, may detect when the rotary movement is complete, re-activating the drive device 44 of the process conveyor 38 followed by all other drive devices 44 of the conveyor system 13 with the exception of the rotary device 66, so that an object 5 behind pushes the object
30 5 located on the rotary device 66 in the direction of the second part of the process conveyor 38, which is then conveyed via the other parts of the conveyor system 13 out of the irradiation chamber.



In order to prevent objects 5 from mutually hampering one another on the process conveyor 38 and the rotary device 66, the rotary device could be displaced out of the plane of the process conveyor 38 once an object 5 has been placed on it, e.g. by raising or lowering it. In addition, to facilitate transport of the objects 5 on the rotary device 66, other conveyor devices, e.g. roller conveyors with or without a drive or similar, may be provided so that an object 5 can be automatically centred on the rotary device 66 as soon as a sensor detects that an object 5 has been moved onto the rotary device 66.

Figs. 8a to 8e provide schematic illustrations of a detail of the transverse conveyor 42 of the conveyor system 13 of the system 1 in order to provide a clearer illustration of how objects 5 are transported in this region and how the conveyor system is timed to expose the objects 5 to radiation from two sides.

Fig. 8a shows objects 5 being conveyed on the feed track 28, the objects 5 being unpacked or in appropriate packaging, e.g. cardboard boxes. In a region 68, the objects 5 lie close together, i.e. without any intermediate spaces, and are fed as indicated by arrow 69 in the direction of the irradiation chamber 16, which is not illustrated, and the linear accelerator 2, also not illustrated. A sensor 70, which may be an optical sensor such as a light sensor for example, detects the presence of objects 5 in its region and activates the stop 33 in response to the data picked up. This stop 33 may be a rail made from the most varied of materials such as metal or plastics or similar and has a non-operating position underneath the feed track 28 whilst a part of its surface projects beyond the feed track 28 when operated so that objects 5 can be held back instead of being carried farther along. The stop 33 may be operated in conjunction with any type of actuator known from the prior art, for example pneumatic, electric, hydraulic, etc.. However, before the stop 33 is activated, care must be taken to ensure that no objects 5 are present on the feed track 28 along a length 71, so as to prevent the goods 5 inadvertently being lifted off the feed track 28. In order to keep this length 71 free, the objects 5 fed across the region 68 are briefly halted and objects 5 already at a region 72 are continuously forwarded along. The advantage of this is that there will now be the required space between the individual objects 5 and the objects 5 can be fed round the corner. As described above, the intermediate spaces are subsequently reduced as far as possible again by the buffer conveyor 37 farther on, not illustrated in Fig. 8, so as to optimise the capacity of the linear accelerator 2.



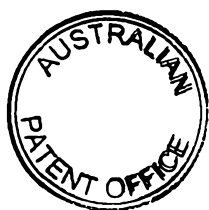
Fig. 8b shows the timing used for objects 5 which have to be irradiated twice, at a point at which untreated objects 5 are fed to the irradiation chamber 16 in the direction of arrow 69 and at which objects 5 which have already been irradiated once, i.e. on one surface, are despatched from the irradiation chamber 16 by the discharge track 42 in the direction of arrow 73. Another sensor 70
5 in the region of the discharge track 43 can detect the presence of objects 5 on the discharge track 43, for example by means of a control and drive unit such as an EDP unit, not illustrated, in the region of the transverse conveyor 36.

Then, as illustrated in Fig. 8c, objects 5 in the region 68 of the feed track 28 are buffered in front
10 of the stop 33 (indicated by circles 74 in Fig. 8c) and the object 5 which is located on the transverse conveyor 42 in the region of the discharge track 43 is moved as indicated by arrow 75 in the direction of the feed track 28. This movement is initiated on the basis of the data picked up by the sensor 70 located in the region of the discharge track 43 and may be operated by using the most varied of positioning technologies known from the prior art. For example, the object 5
15 could be pushed onto the region of the transverse conveyor 42 of the feed track 28 by means of a displacement device 76, for example a ram 77 and a rod linkage 78. Alternatively, this displacement device 76 may be pneumatically operated, in which case the object 5 will be displaced in said direction by a blast of air. However, it would also be possible to construct at least a part of the transverse conveyor 42 as a roller track so that a short pulse could be applied to the object 5
20 by means of an appropriate displacement device 76 in order to achieve the desired displacement in the direction required.

Clearly, however, it would also be possible for at least parts of the transverse conveyor 42 to be
25 provided with drive devices 44, for example a servo motor, as illustrated in Fig. 8c.

As illustrated in Fig. 8d, the objects 5 leaving the irradiation chamber 16 are transferred back to the feed track 28 in the region 72. Since the feed track 28 is preferably driven by means of a drive device 44, for example a servo motor, in the region 72, the objects 5 which have been irradiated once are buffered in the region 68, again in the direction of arrow 69. The objects 5 are preferably
30 buffered until the first object 5 which has been irradiated twice, i.e. on opposing surface, reaches the corresponding sensor 70 in this region on the discharge track 43.

As a result, the sensors 70 detects, via a control and drive device, not illustrated, the treatment



status of the objects 5, in particular the fact that the objects 5 have been irradiated twice, by means of the marking applied to the objects 5 as described above and moves the stop 33 into its non-operating position so that no part of the stop 33 is projecting above the surface of the feed track 28. Consequently, as illustrated in Fig. 8e, the buffered objects 5 can be directed as indicated by arrow 69 towards the radiation process whilst objects 5 which have completed the radiation process can be removed from the irradiation process via the discharge track 43 as indicated by arrow 73.

With a conveyor system of this design, the objects 5 are not rotated on the transverse conveyor 42 but are fed in a horizontal displacement only and are positioned on the feed track 28 so that they can be directed back round the circuit in the irradiation chamber 16 rotated by almost 180° about their vertical axis.

At this point, it should be reiterated that Figs. 8a to 8e provide a schematic illustration of the conveyor system 13 in the region of the transverse conveyor 42 and that any drive devices 44 and sensors 70 can be mounted in the requisite positions in order to ensure that the objects 5 are conveyed along on the conveyor system 13 smoothly.

The method described below has proved to be particularly effective as a means of irradiating the objects 5, although this approach does not necessarily have to be used and can be modified as required.

The object 5 to be irradiated is fed across the unclean feed region 24 to the conveyor system 13. This may be done manually by picking up the objects 5 from transport containers 27, for example pallets.

In order to identify the objects 5 individually, they are fed past a marker device 31, for example a label dispenser. Having been applied in this manner, these markings, which may be a bar code for example, are detected by a downstream scanner 32 and this data is fed to a control and/or drive device, for example an EDP system. A first stop 33 co-operates with the scanner 32, in front of which objects 5 from the feed region 24 are buffered. The stop 33 passes the objects onto the delivery track 34 at intervals calculated on the basis of the sterilisation status.



The objects 5 are then fed across the individual parts of the conveyor system 13 into the irradiation chamber 16. In order to determine the dose of radiation energy to be applied to the objects 5, it is important that the feed rate of the process conveyor 38, amongst other things, is adapted to the cyclical frequency of the linear accelerator 2. Since the electrons are accelerated by electromagnetic waves pulsed at a predefined frequency, present as stationary waves in cavity resonators 6, and excited by a pulsed microwave generated by an oscillator 7 and amplified by a klystron, it has proved advantageous if the pulses of the electron beam overlap by at least 30%, preferably 50%. Accordingly, a dose can be uniformly distributed in the object 5.

10 It is of advantage to use an accelerator system in which a beam energy in the region of 5 MeV to 30 MeV, preferably 10 MeV, is applied and a mean beam output in the region of 5 kW to 30 kW, preferably 15 kW.

The feed rate of the process conveyor 38 should be between 1 mm/s and 400 mm/s, preferably 5 mm/s and 200 m/s and in any event adjusted to the dose to be administered.

The object 5 is preferably irradiated horizontally and vertically relative to the direction of displacement of the object 5 and irradiation may be applied from all sides, especially if several electron accelerators are used. In the latter case, the object 5 may be irradiated from all sides on an alternating basis or simultaneously, preferably in a vertical and horizontal direction relative to the conveyor system 13. Once irradiated, the object 5 is transported through the labyrinthine access out of the irradiation chamber 16 and on past an identification system, for example a scanner 32, in particular a reading head. The data picked up may also be applied to an EDP system, which will therefore be able to ascertain the degree to which the object 5 has been treated. If it is necessary to irradiate the object 5 more than once, this data will be applied to a stop 33, which, in conjunction with the transverse conveyor 42, will cause the objects 5 on the delivery track 34 to be held back, by moving out a metal and/or plastic batten, instead of being transported on into the irradiation chamber 16. Consequently, objects 5 that have already been irradiated can be returned via the transverse conveyor 442 to the delivery track 34 and fed back into the irradiation process. The objects 5 located on the feed track 28 can be held back by means of the first stop 33 and buffered until the first object 5 that has been irradiated twice reaches the transverse conveyor 42 again. The fact that irradiation has been applied twice will be detected by the scanner 32.



By controlling the system in this way, the capacity of the resources available can advantageously be used to good effect. Optionally, in addition to the first stop 33, other stops 33 could be mounted across the length of the conveyor system 13. Preferably, these would be positioned before each change of direction in the transport system. As a result, the objects 5 would be buffered
5 so that any disruption to the flow of goods before the electron-emitting device 14 is prevented as far as possible. The objects 5 are released from each of the stops 33 at defined intervals, timed to coincide with the dose of radiation to be applied to the objects 5, i.e. they are fed past the electron beam several times by parts of the conveyor system 13, in particular the process conveyor 38, in order to achieve the required radiation dose.

10

Usually, the objects 5 are fed into and out of the irradiation chamber 16 from one side of the irradiation chamber 16. However, it would also be possible for the objects 5 to be fed in and out of the irradiation chamber 16 from different sides of the irradiation chamber 16.

15 To determine the dose required for individual objects 5, dosimeters, for example radio-chromium film meters, could be mounted on individual objects 5 at significant points and these objects exposed to the radiation process. These significant points might be those points at which a higher or lower dose is needed. This is likely to be the case with the interior, but also the corner regions of the objects 5, especially if the objects 5 are irradiated in packaging, for example their original
20 packaging, so that the dosimeters used can preferably be placed at these points.

Radio-chromium film meters are excellent because their colour changes depending on the irradiation time and the dose to be administered. This colour change can therefore be measured by means of a spectral photometer by measuring the drop in intensity of a light beam passing
25 through or its reflection. The resultant values can be used to work out the exact speed at which the process conveyor 38 needs to be fed along at a constant beam output. Alanine transfer dosimeters have proved to be of particular advantage in determining the calibration curve for evaluating the films. Clearly, however, any other methods could be used for calibration purposes.

30 In addition to radio-chromium film dosimeters, other dose meters could be used to enhance safety, preferably calorimetric dose meters.

To improve safety still further, additional film dosimeters could be attached to objects 5 at de-



fined intervals along the route of the production process, preferably dosimeters carrying the same marker or identification as that used for the objects 5. This would prevent the individual film dose meters from being mixed up later. The objects 5 fitted with the additional dosimeters can be recognised by means of a control and/or drive device by means of a scanner 32, for example.

5

For the purposes of subsequent processing and in order to control the stability of the process, the data obtained from the dosimeters could be applied to a data processing system, by which it could be archived.

10

Clearly, however, it would also be possible for the data picked up from the dosimeters to be used for the purposes of a DESIRED/ACTUAL comparison in order to control the parameter settings of the accelerator system and the drive speeds of the individual parts of the conveyor system. To this end, the DESIRED values could be stored in said data processing system.

15

Finally, it should be pointed out that in order to provide a clearer understanding of the solutions proposed by the invention, examples of embodiments and their individual components are illustrated to a certain extent out of scale and/or on an enlarged and/or reduced scale. Furthermore, individual parts of the combination of features described above may be used in combination with other individual features from other examples of embodiments to provide an independent solu-

20

tion or a solution of the invention.

In particular, the individual embodiments illustrated in Figs. 1, 2; 3; 4; 5; 6; 7; 8a to 8e may form the subject-matter of independent solutions to the invention in their own right. The tasks set and solutions proposed by the invention are to be found in the detailed descriptions of these draw-

25 ings.



List of reference numbers

- 1 System
- 2 Linear accelerator
- 3 Incandescent cathode
- 4 Quadrupole magnet
- 5 Object
- 6 Cavity resonator
- 7 Oscillator
- 8 Microwave amplifier
- 9 High-voltage modulator
- 10 Energy source
- 11 Shutter
- 12 Deflector magnet
- 13 Conveyor system
- 14 Electron-emitting device
- 15 Beam stop
- 16 Irradiation chamber
- 17 Beam stop
- 18 Wall
- 19 Wall
- 20 Wall
- 21 Wall
- 22 Wall
- 23 Floor plate
- 24 Feed region
- 25 Barrier device
- 26 Discharge region
- 27 Conveyor unit
- 28 Feed track
- 29 Control console
- 30 Emergency Stop switch



| | |
|----|-----------------------|
| 31 | Marker device |
| 32 | Scanner |
| 33 | Stop |
| 34 | Delivery track |
| 35 | Conveyor |
| 36 | Transverse conveyor |
| 37 | Buffer conveyor |
| 38 | Process conveyor |
| 39 | Conveyor |
| 40 | Rising conveyor |
| 41 | Roller track |
| 42 | Transverse conveyor |
| 43 | Discharge track |
| 44 | Drive device |
| 45 | Protective device |
| 46 | Door |
| 47 | Cable pull switch |
| 48 | Observation camera |
| 49 | Return conveyor |
| 50 | Corner-turning device |
| 51 | Ring |
| 52 | Deflector device |
| 53 | Window |
| 54 | Contact |
| 55 | Line |
| 56 | Actuator |
| 57 | Point |
| 58 | Arrow |
| 59 | Arrow |
| 60 | Tipping point |
| 61 | End face |
| 62 | Stop |
| 63 | Actuator |



| | |
|----|---------------------------|
| 64 | Point |
| 65 | Guide device |
| 66 | Rotary device |
| 67 | Observation device |
| 68 | Region |
| 69 | Arrow |
| 70 | Sensor |
| 71 | Length |
| 72 | Region |
| 73 | Arrow |
| 74 | Circle |
| 75 | Arrow |
| 76 | Direction of displacement |
| 77 | Ram |
| 78 | Rod linkage |



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A method of altering the properties, at least in a part region, of and/or treating objects, in particular a material, an item of waste, a component, a foodstuff, a liquid, a gas or similar, whereby the objects are displaced by means of a process conveyor alongside at least one electron-emitting device, in particular an electron accelerator, in an irradiation chamber, the electrons from an incandescent cathode needed for irradiation purposes being focused and pulsed in an accelerator unit with waves pulsed at a specific, pre-definable frequency and being emitted from the electron-emitting device at a specific frequency and directed onto the object to be irradiated, characterised in that the objects are transferred from a buffer conveyor to the process conveyor, the speed of the transfer being predetermined by a control system by means of an adjustable drive device so that objects already located on the process conveyor are not pushed and the objects are fed past the electron-emitting device without any intermediate spaces.
2. A method as claimed in claim 1, characterised in that electromagnetic waves are used to accelerate the electrons.
3. A method as claimed in claim 1 or claim 2, characterised in that cavity resonators are used to generate the electromagnetic waves.
4. A method as claimed in one or more of the preceding claims, characterised in that the stationary wave is excited by a pulsed microwave in the accelerator unit.
5. A method as claimed in any one of the preceding claims, characterised in that the pulsed microwaves are generated by an oscillator and preferably amplified by a klystron.
6. A method as claimed in any one of the preceding claims, characterised in that the feed rate of the process conveyor is set up on the basis of the scanning height and the number of pulses as well as the pulse period, such that the pulses of the electron beam overlap by at least 30%, preferably 50%.
7. A method as claimed in any one of the preceding claims, characterised in that the electrons are beamed at an energy of 5 MeV to 30 MeV, preferably 10 MeV.
8. A method as claimed in any one of the preceding claims, characterised in that the feed rate of the process conveyor is preferably between 1 mm/s and 400 mm/s, preferably between 5 mm/s and 200 mm/s.



9. A method as claimed in any one of the preceding claims, characterised in that a mean beam output in the range of 4 kW to 30 kW, is used.
10. A method as claimed in any one of the preceding claims, characterised in that the object is irradiated more or less horizontally relative to the
5 direction of displacement of the object.
11. A method as claimed in any one of the preceding claims, characterised in that the object is irradiated more or less vertically relative to the direction of displacement of the object.
12. A method as claimed in any one of the preceding claims, characterised
10 in that several electron accelerators are used to irradiate the object.
13. A method as claimed in any one of the preceding claims, characterised in that the object is irradiated alternately from several sides, preferably in a vertical and a horizontal direction relative to the conveyor system.
14. A method as claimed in any one of the preceding claims, characterised
15 in that the object is irradiated from several sides simultaneously, preferably in a vertical and a horizontal direction relative to the conveyor system.
15. A method as claimed in any one of the preceding claims, characterised in that a dosimeter, preferably a radio-chromium film dosimeter, is used to measure the dose applied to the object.
- 20 16. A method as claimed in any one of the preceding claims, characterised in that alanine transfer dosimeters are preferably used to generate the calibration curve for evaluating the film.
17. A method as claimed in any one of the preceding claims, characterised in that after evaluating the film dosimeter by measuring the intensity of a
25 light beam passing through the film dosimeter in transmission, the detected characteristics are transferred to an EDP system for processing, storage and control purposes.
18. A method as claimed in any one of the preceding claims, characterised in that the irradiation dose acting on the object is detected by additional
30 dosimeters, preferably calorimetric dosimeters.
19. A method as claimed in any one of the preceding claims, characterised in that the object is fed by the conveyor system past the electron-emitting device of the accelerator unit, in particular the scan horn, at a speed which depends on the dose to be administered.
- 35 20. A method as claimed in any one of the preceding claims, characterised in that at least one marker, for example a bar code, is applied to the object



and/or the packaging of the object, which is detected by an identification system, for example a scanner, in particular a reading device.

21. A method as claimed in any one of the preceding claims, characterised in that at least one marker is applied to the chosen dosimeter, in particular the film dosimeter, for subsequently evaluating, identifying and checking the dosimeter, in particular a bar code, which is detected by an identification system, for example a scanner, in particular a reading device.

22. A method as claimed in any one of the preceding claims, characterised in that the object is buffered at a first stop on the basis of the identification system.

23. A method as claimed in any one of the preceding claims, characterised in that the object or objects is or are buffered at two predetermined points of the conveyor system at least, in particular at points at which there is a change of direction.

24. A method as claimed in any one of the preceding claims, characterised in that several objects or several transport containers filled with objects, for example cardboard, plastic or

25. A method as claimed in any one of the preceding claims, characterised in that the object is fed to the irradiation chamber by a delivery conveyor at intervals calculated on the basis of the degree to which it has been treated.

26. A method as claimed in any one of the preceding claims, characterised in that the degree to which the object has been detected by a scanner, for example a bar code reader or similar.

27. A method as claimed in any one of the preceding claims, characterised in that the object is fed from the discharge transport device back to the delivery conveyor depending on the degree of treatment, preferably by means of a transverse conveyor, so that the object can be passed back through the irradiation process at a definable angle, preferably 180°.

28. A method as claimed in any one of the preceding claims, characterised in that the object is fed past the electron beam several times, for example by repeatedly changing the direction of displacement.

29. A method as claimed in any one of the preceding claims, characterised in that the objects are transported in and out of the irradiation chamber from one side of the irradiation chamber.



30. A method as claimed in any one of the preceding claims, characterised in that the objects are fed in and out of the irradiation chamber from different sides of the irradiation chamber.

31. A method as claimed in any one of the preceding claims, characterised
5 in that the object is removed from the processing area by means of a discharge conveyor device.

32. A method as claimed in any one of the preceding claims, characterised in that the electron beam strikes the surface of the object in the form of a geometric, preferably almost wave-type curve, set by the combination of the
10 displacement of the object with the displacement of the electron beam, in particular a saw-tooth curve.

33. A method as claimed in any one of the preceding claims, characterised in that a preliminary test is conducted on at least one object to determine the requisite radiation dose by means of dosimeters attached to marker points of
15 the object, particularly at those points at which the beam output is particularly low and/or high because of the scanning mode, for example at the centre of the surface and/or in the interior of the object and in the corners of the object.

34. A method as claimed in any one of the preceding claims, characterised
20 in that the calculated radiation dose required is applied to a control unit, for example an EDP system, which determines and monitors the requisite speeds of the individual conveyor devices on the basis of these values.

35. A method as claimed in any one of the preceding claims, characterised in that, for control purposes during the production process, dosimeters are
25 attached to individual objects at defined intervals, preferably to the outer surface, by means of which the radiation process can be controlled.

36. A method as claimed in any one of the preceding claims, characterised in that an identification system co-operating with the control unit detects the objects to which dosimeters are attached.

30 37. A method as claimed in any one of the preceding claims, characterised in that the data picked up from the individual objects during the radiation process is applied to a data processing system.

38. A method as claimed in any one of the preceding claims, characterised in that the speed of individual parts of the system, in particular the process
35 conveyor, is regulated on the basis of a DESIRED/ACTUAL comparison of the dose applied.



39. A method as claimed in any one of the preceding claims, characterised in that the parameter settings of the electron accelerator system are regulated on the basis of a DESIRED/ACTUAL comparison of the dose applied.

40. A system for changing the properties, at least in a part-region, of and/or
5 for treating objects, in particular a material, an item of waste, a component, a foodstuff, a liquid, a gas or similar, having a conveyor system for the objects to be processed, having a process conveyor of a conveyor system for the objects to be treated, with a source for generating free electrons, an
10 accelerator system for the free electrons, an irradiation chamber in which the objects are irradiated and which is surrounded by walls to protect against radiation, characterised in that the conveyor system is set up in such a way that, in order to improve the efficiency of the system, the objects to be irradiated are fed past the electron-emitting device from the accelerator unit without any spaces in between them, a buffer conveyor with a drive device
15 controlled by a control system being arranged before the process conveyor in the direction of displacement.

41. A system as claimed in any one of the preceding claims, characterised in that the objects to be irradiated are fed in and out via at least one labyrinthine entrance to the irradiation chamber.

20 42. A system as claimed in claim 40 and/or claim 41, characterised in that the objects are fed into and out of the irradiation chamber from one side of the anti-radiation walls through at least one labyrinthine entrance.

43. A system as claimed in any one of claims 40 to 42, characterised in that the objects are fed into and out of the irradiation chamber from different sides
25 of the anti-radiation walls through respective labyrinthine entrances for feeding the objects in and out .

44. A system as claimed in any one of claims 42 to 43, characterised in that at one point of the conveyor system at least, a device is provided, for example a stop made from metal and/or plastics or similar, so that the objects can
30 automatically be placed upright and so that they can be fed past the electron beam at a defined angle relative to the electron-emitting device, preferably 90°.

45. A system as claimed in any one of claims 40 to 44, characterised in that the region of the conveyor system outside the electron accelerator consists of
35 two separate regions, the unclean feed region being separated from the clean discharge region by a barrier device.



46. A system as claimed in any one of claims 40 to 45, characterised in that the barrier device is a grating, a barrier wall or similar.

47. A system as claimed in any one of claims 40 to 46, characterised in that access of persons to the irradiation chamber is permitted only by means of a protective device, for example a door in a dividing wall, which may
5 preferably be a grille.

48. A system as claimed in any one of claims 40 to 47, characterised in that unauthorised access to the irradiation chamber is prevented by additional measures, for example an electronic locking system on the protective device,
10 when electrons are being emitted from the linear accelerator.

49. A system as claimed in any one of claims 40 to 48, characterised in that a beam interrupter automatically interrupts the electron beam if anybody enters the irradiation chamber.

50. A system as claimed in any one of claims 40 to 49, characterised in that
15 the accelerator is a linear accelerator.

51. A system as claimed in any one of claims 40 to 50, characterised in that the accelerator is a ring accelerator.

52. A system as claimed in any one of claims 40 to 51, characterised in that the electron-emitting device is a scan horn.

20 53. A system as claimed in any one of claims 40 to 52, characterised in that the scan horn is set up so that the scanning height is up to 100 cm, preferably 60 cm.

54. A system as claimed in any one of claims 40 to 53, characterised in that the electron-emitting device describes a circle around the conveyor system.

25 55. A system as claimed in any one of claims 40 to 54, characterised in that the conveyor system is designed so that the object to be irradiated is fed past the electron-emitting device in a packaging, in particular its original packaging.

56. A system as claimed in any one of claims 40 to 55, characterised in that
30 the electron accelerator is designed so that when the dose is applied, the object is penetrated by the electron beam to a depth of 50 cm, preferably 30 cm, largely independent of the travel path through the object.

57. A system as claimed in any one of claims 40 to 56, characterised in that the energy of the electrons is between 5 MeV and 30 MeV, preferably 10 MeV.



58. A system as claimed in any one of claims 40 to 57, characterised in that the accelerator unit is so dimensioned that it has a mean beam output of 4 kW to 30 kW, preferably 15 kW.

59. A system as claimed in any one of claims 40 to 58, characterised in that
5 the electron beam is directed onto the object to be irradiated by means of a deflector device, e.g. deflector magnets.

60. A system as claimed in any one of claims 40 to 59, characterised in that by mounting deflector devices, e.g., deflector magnets, preferably on the electron-emitting device, in particular on the scan horn, the electron beam
10 strikes at least a part-region of the surface of the object.

61. A system as claimed in any one of claims 40 to 60, characterised in that the electron beam is pulsed.

62. A system as claimed in any one of claims 40 to 61, characterised in that in order to distribute the dose uniformly in the object on the conveyor
15 system, a forward speed can be set which overlaps with the pulses by at least 30%, preferably 50%.

63. A system as claimed in any one of claims 40 to 62, characterised in that the electrons are accelerated with electromagnetic waves.

64. A system as claimed in any one of claims 40 to 63, characterised in that
20 cavity resonators are provided in order to generate electromagnetic waves along the accelerator path.

65. A system as claimed in any one of claims 40 to 64, characterised in that the cavity resonators are made from metal, for example copper, copper alloys with bronze, brass, etc., steel, ceramic, plastics or similar.

25 66. A system as claimed in any one of claims 40 to 65, characterised in that the stationary wave in the accelerator unit is excited by a pulsed microwave.

67. A system as claimed in any one of claims 40 to 66, characterised in that the microwaves are generated by an oscillator and are amplified by a microwave amplifier preferably a klystron.

30 68. A system as claimed in any one of claims 40 to 67, characterised in that energy is supplied to the microwave amplifier by means of a high-voltage modulator.

69. A system as claimed in any one of claims 40 to 68, characterised in that
35 the accelerator unit is so arranged that the object is irradiated horizontally to the direction in which the object is conveyed.



70. A system as claimed in any one of claims 40 to 69, characterised in that the accelerator unit is so arranged that the object is irradiated vertically to the direction in which the object is conveyed.

71. A system as claimed in any one of claims 40 to 70, characterised in that
5 the irradiation is directed from above and/or from underneath.

72. A system as claimed in any one of claims 40 to 71, characterised in that the conveyor system is designed in such a way that the object can be irradiated from several sides simultaneously.

73. A system as claimed in any one of claims 40 to 72, characterised in that
10 the object can be rotated by a defined angle, preferably 180°.

74. A system as claimed in any one of claims 40 to 73, characterised in that the conveyor system is designed so that the object can be displaced through the electron beam at a defined speed.

75. A system as claimed in any one of claims 40 to 74, characterised in that
15 a forward speed of 1 mm/s to 400 mm/s, preferably 5 mm/s to 200 mm/s can be set on the conveyor system.

76. A system as claimed in any one of claims 40 to 75, characterised in that the conveyor system consists of continuous conveyors, for example a roller track and/or a chain conveyor.

77. A system as claimed in any one of claims 40 to 76, characterised in that
20 the conveyor system consists of a feed track, a delivery track, a process conveyor, a buffer conveyor, a rising conveyor, a transverse conveyor, at least one corner-turning device and a discharge track.

78. A system as claimed in any one of claims 40 to 77, characterised in that
25 at least one marker device for the object, for example a label dispenser, a device for applying microchips or similar, is provided, at least on the conveyor system.

79. A system as claimed in any one of claims 40 to 78, characterised in that the labels are provided with a bar code.

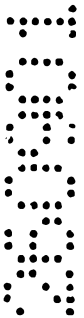
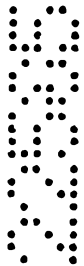
80. A system as claimed in any one of claims 40 to 79, characterised in that
30 the microchips are fitted with transmitters, for example an IR transmitter.

81. A system as claimed in any one of claims 40 to 80, characterised in that a receiver station for IR rays is provided in the region of the conveyor system.

82. A system as claimed in any one of claims 40 to 81, characterised in that
35 at least one scanner, for example a reader or similar, is mounted on the conveyor system to detect the objects.



83. A system as claimed in any one of claims 40 to 82, characterised in that the conveyor system has at least one stop.
84. A system as claimed in any one of claims 40 to 83, characterised in that a stop is provided before each change of direction in the conveyor system.
- 5 85. A system as claimed in any one of claims 40 to 84, characterised in that the actuator for a stop preferably consists of a valve coil, two reed switches and a driver roller.
86. A system as claimed in any one of claims 40 to 85, characterised in that a servo motor is preferably provided to drive individual parts of the conveyor
10 system.
87. A system as claimed in any one of claims 40 to 86, characterised in that the conveyor system has a counting station to detect objects which have been irradiated on only one side.
88. A system as claimed in any one of claims 40 to 87, characterised in that
15 the counting system preferably comprises three sensors.
89. A system as claimed in any one of claims 40 to 88, characterised in that a control console is mounted in the feed region having at least one Emergency-Stop switch.
90. A system as claimed in any one of claims 40 to 89, characterised in that
20 at least parts of the feed track are driven.
91. A system as claimed in any one of claims 40 to 90, characterised in that the process conveyor is preferably wire mesh belt.
92. A system as claimed in any one of claims 40 to 91, characterised in that the system has at least one heat exchanger.
- 25 93. A system as claimed in any one of claims 40 to 92, characterised in that at least on one venting device, for example a ventilator, is provided in the irradiation chamber.
94. A method of altering the properties, at least in a part-region, of and/or treating objects substantially as described with reference to the accompanying
30 figures.



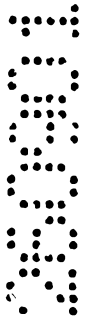
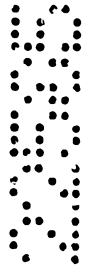
95. A system for changing the properties, at least in a part-region, of and/or for treating objects, substantially as described with reference to the accompanying figures.

Dated this 25th day of September 2001

Mediscan GmbH

Patent Attorneys for the Applicant:

F B RICE & CO



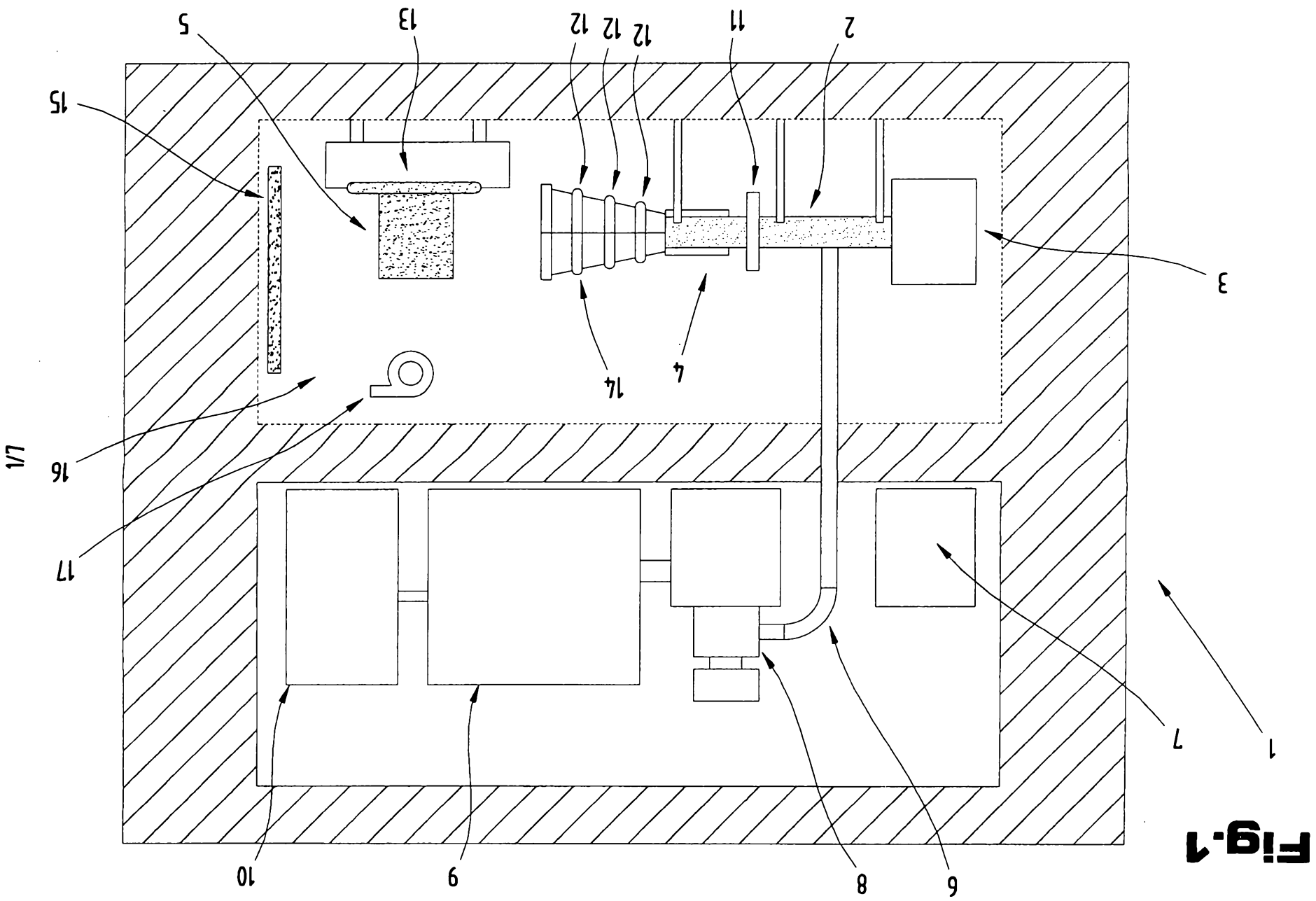


Fig. 1

Fig.2

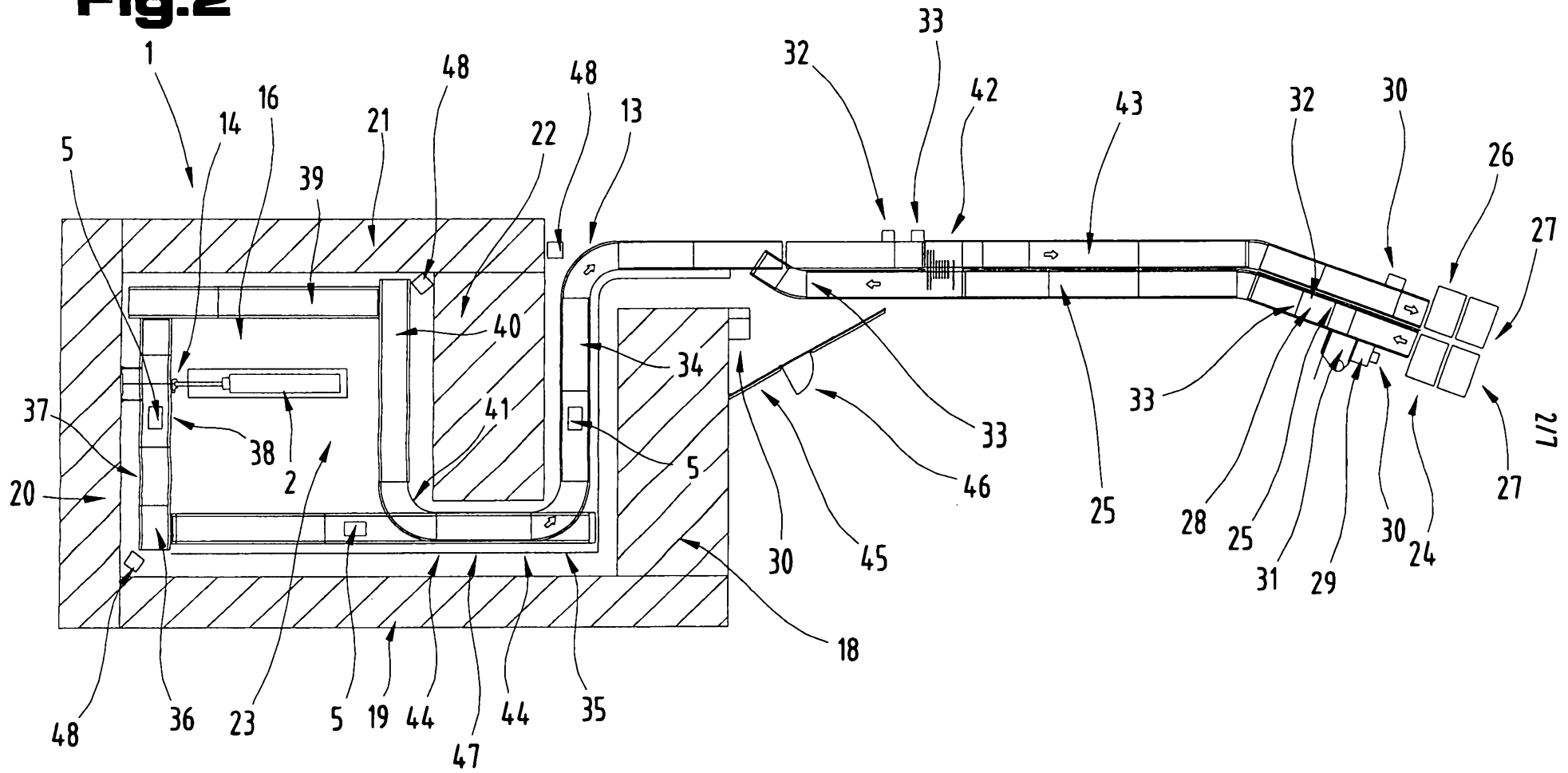


Fig.3

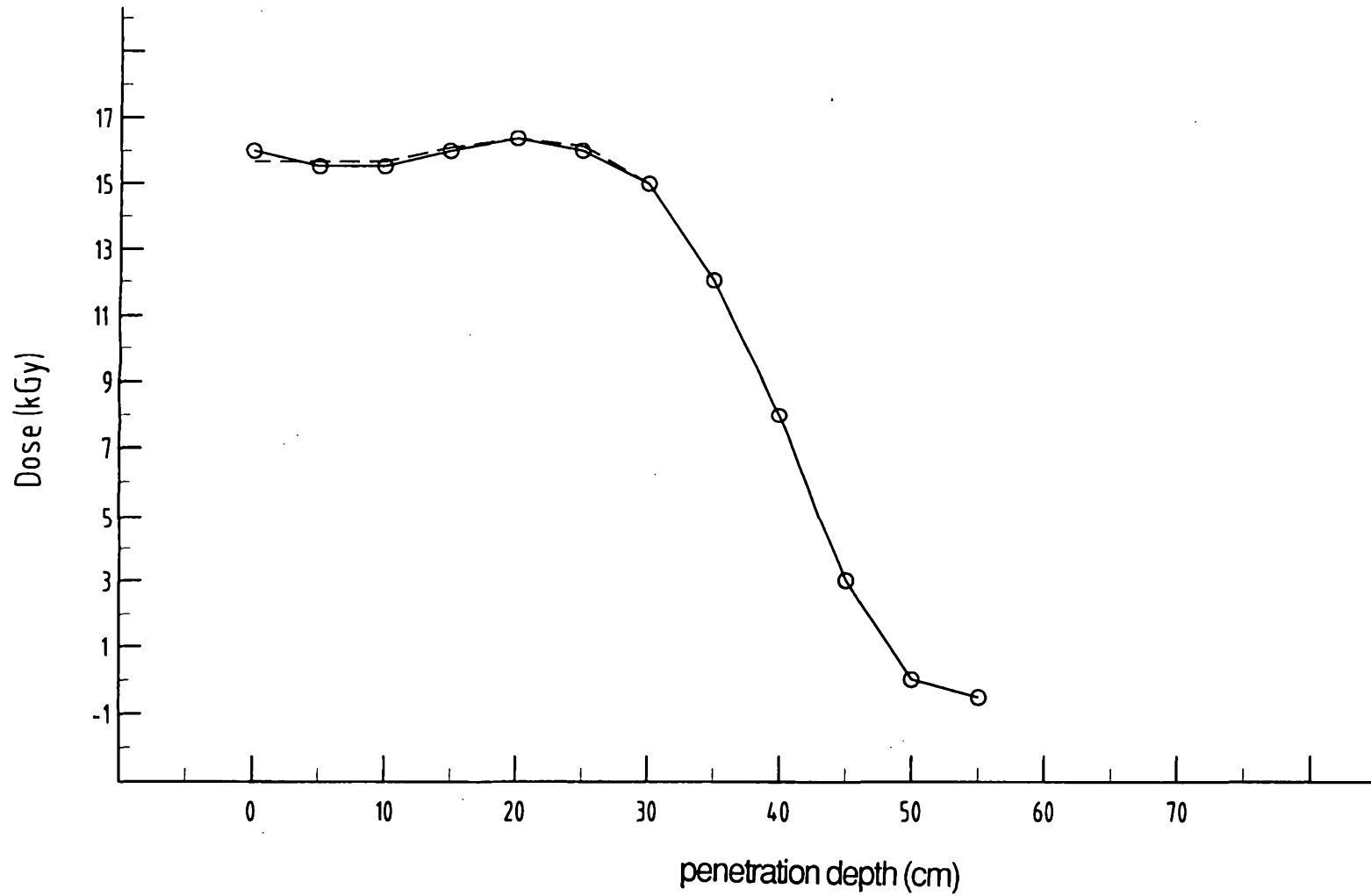


Fig.4

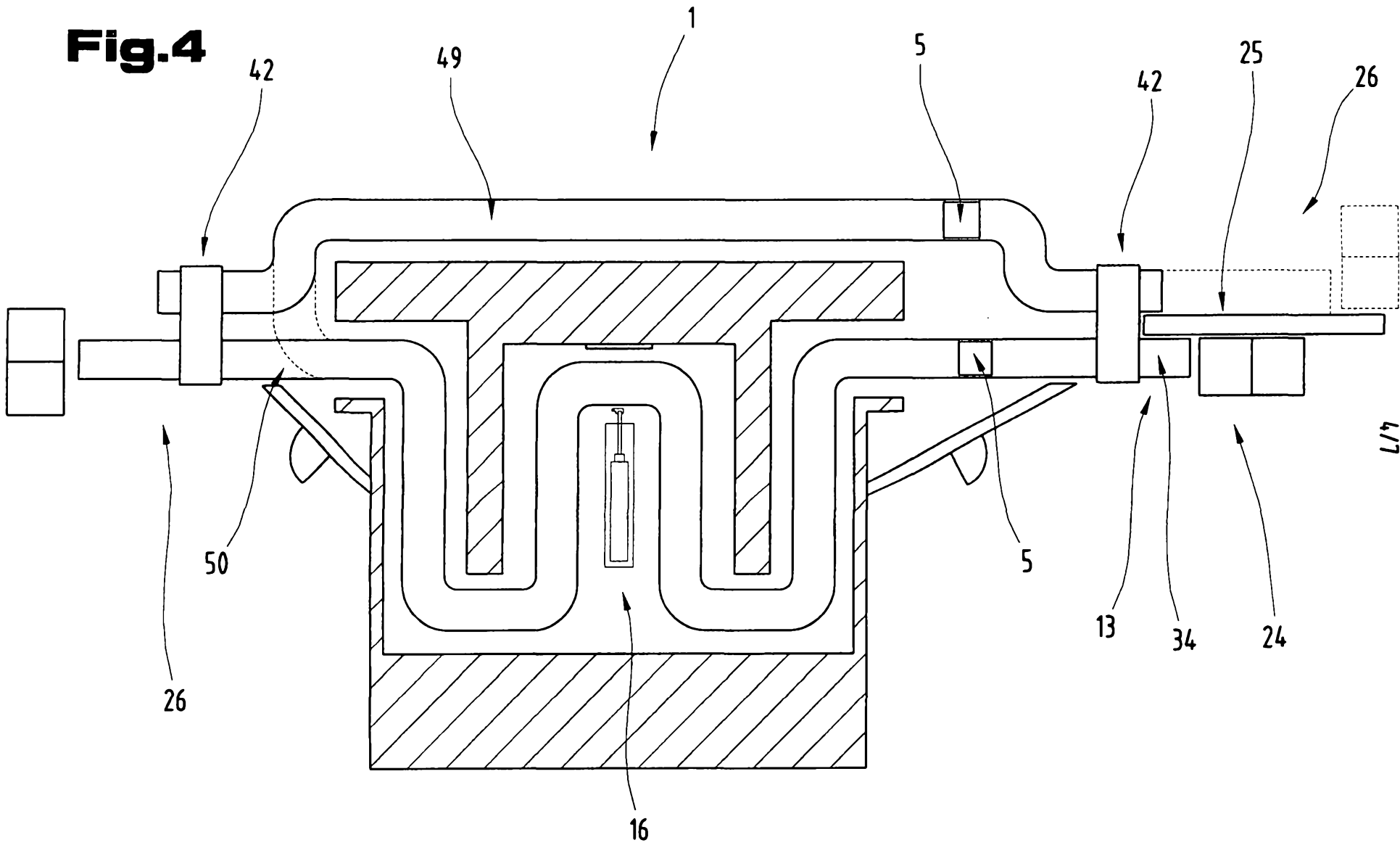


Fig.5

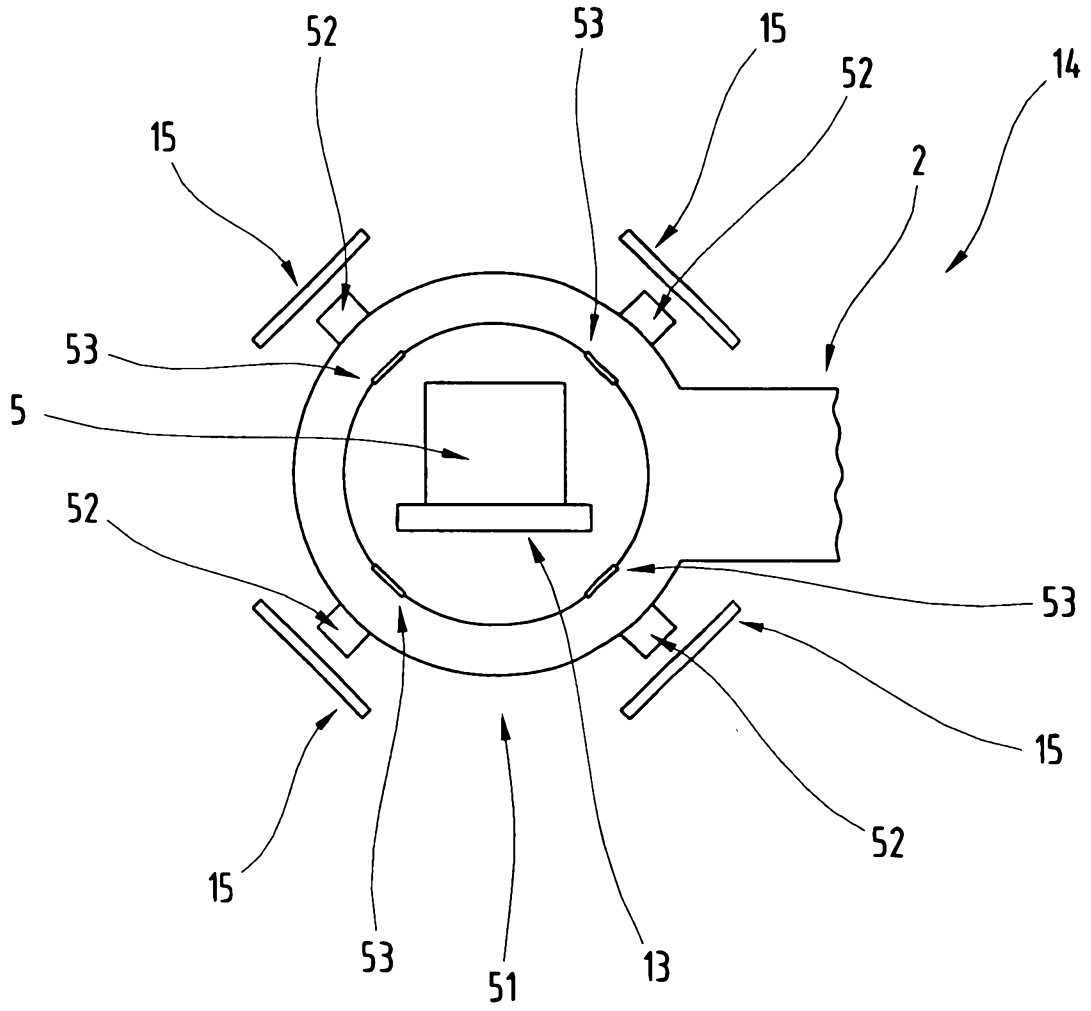


Fig.6

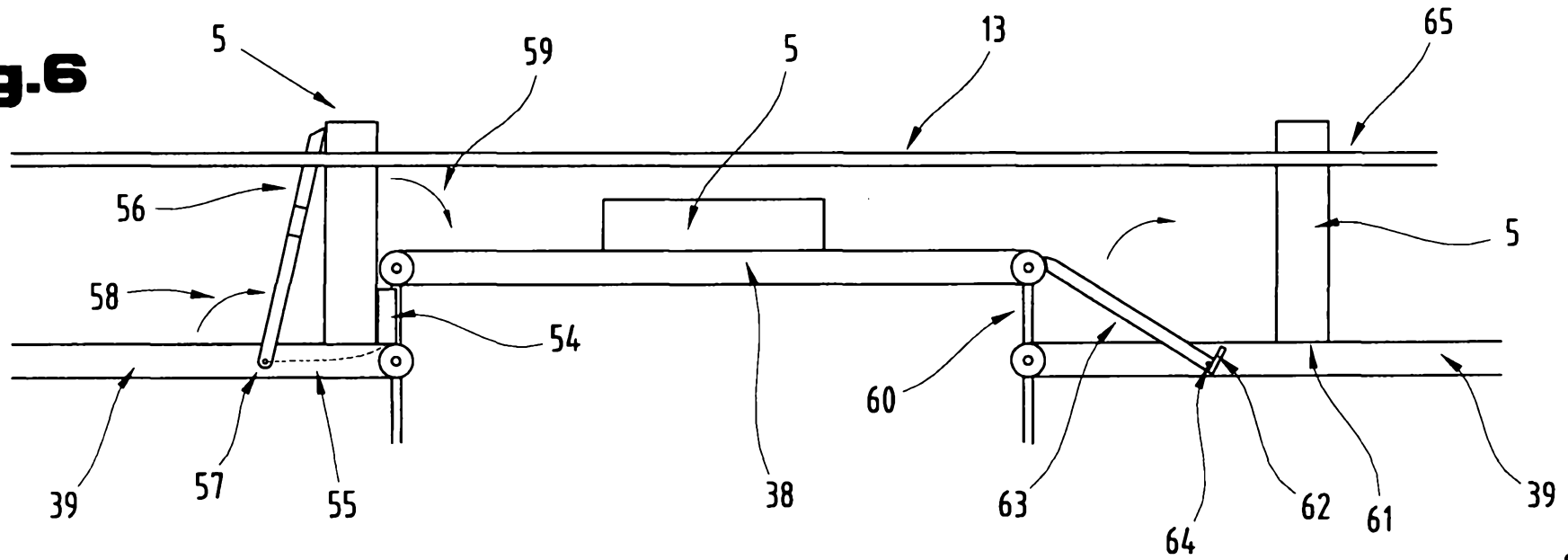


Fig.7

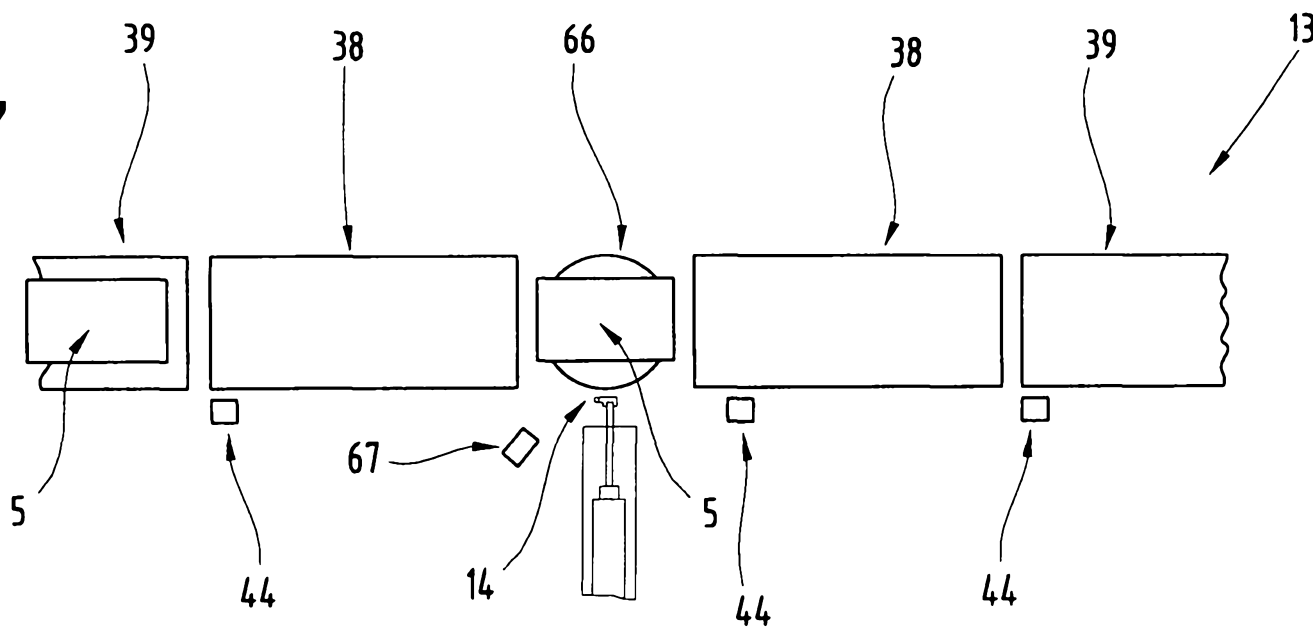


Fig. 8a

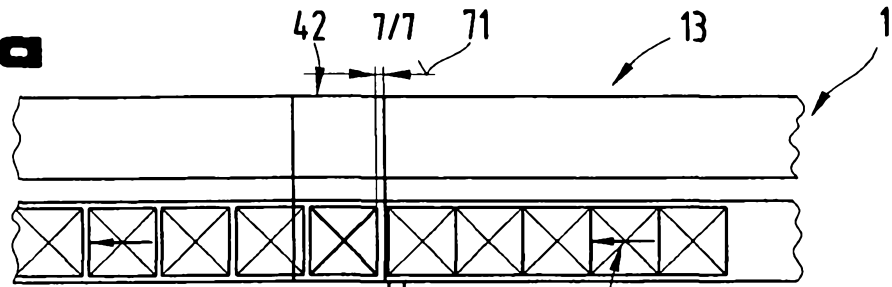


Fig. 8b

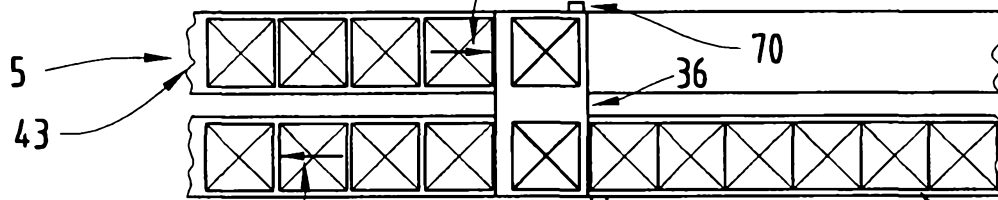


Fig. 8c

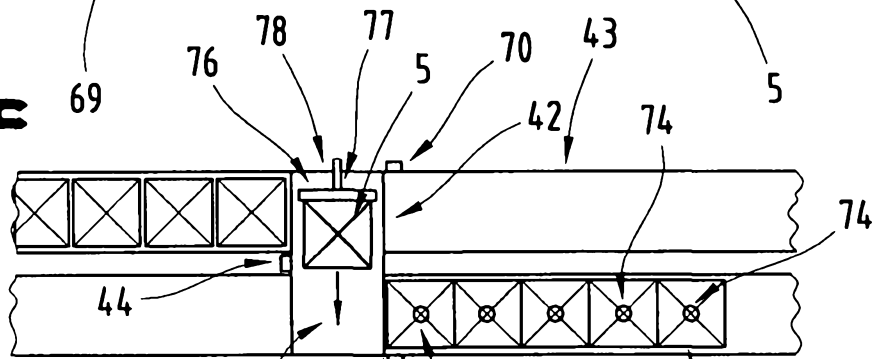


Fig. 8d

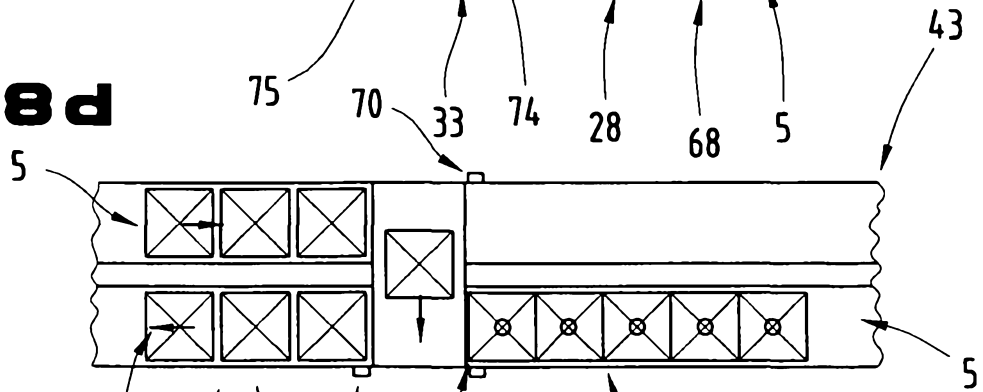


Fig. 8e

