(CONVENTION. By one or more persons and/or a Company) 644420 Form 4.

COMMONWEALTH OF AUSTRALIA

Patents Act 1952-1969

CONVENTION APPLICATION FOR A PATENT

(1) Here insert (in full) Name or Names of Applicant or Applicants, followed by Address(es).

I/We (1) JEAN LOUIS EMILE ROUX, 63 rue Montgolfier, 69006 Lyon, France.

(2) Here insert Title of Invention.

hereby apply for the grant of a Patent for an invention entitled: (2) PROCESS FOR THE STERILISATION OF CONTAMINATED WASTE AND DEVICE FOR CARRYING OUT THE SAME.

which is described in the accompanying complete specification. This application is a Convention application and is based on the application numbered (3) 90 04960

(3) Here insert number(s) of basic application(s).

(4) Here insert Name of basic Country or Countries, and basic date or dates.

for a patent or similar protection made in (4) France on 9th April, 1990

My/Our address for service is WATERMARK PATENT & TRADEMARK ATTORNEYS 290 Burwood Road, Hawthorn, Victoria, Australia.

DATED this 5th day of April, 1991

(5) Signature(s) of Applicant(s) or Seal of Company and Signatures of its Officers as prescribed by its Articles of Association.

By: (5) JEAN LOUIS EMILE ROUX

LOUIS C. GEBHARDT

Registered Patent Attorney

To: THE COMMISSIONER OF PATENTS.

WATERMARK PATENT & TRADEMARK ATTORNEYS

Form 8

(CONVENTION. One or more persons.)

COMMONWEALTH OF AUSTRALIA

Patents Act 1952-1969

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

(1) Here insert (in full) Name or Names of Applicant or Applicants

In support of the Convention Application made by[1] JEAN LOUIS EMILE ROUX

(2) Here insert title of Invention.

for a patent for an invention entitled:[2] PROCESS FOR THE STERILISATION OF CONTAMINATED WASTE AND DEVICE FOR CARRYING OUT THE SAME.

~~I~~ / We[1] JEAN LOUIS EMILE ROUX,

of 63 rue Montgolfier, 69006 Lyon, France.

(3) Here insert (in full) Address or Addresses

of[3]

do solemnly and sincerely declare as follows:

1. I am / ~~We are~~ the applicant for the patent.

2. The basic application as defined by Section 141 of the Act was made in[4] France

(4) Here insert basic Country or Countries followed by date or dates and basic Applicant or Applicants.

on the 9th day of April, 19 90, by JEAN LOUIS EMILE ROUX

~~on the xxxxxxxxxxxxxxxxxxxxxxxx day of xxxxxxxxxxxxxxxxxx 19xxxx, by xx~~

3. I am / ~~We are~~ the actual inventor of the invention referred to in the basic application

~~or xx~~

(5) Here insert full Name(s) and Address(es) of actual Inventor(s) if other than Applicant(s).

3.[5]

~~the actual inventor of the invention and the facts upon which I am / We are entitled to make the application are as follows: xxxx~~

(6) Full Name of actual Inventor or Inventors.

~~I xxx~~ / ~~We are~~ ~~the assignee xx of the said~~[6]

4. The basic application referred to in paragraph 2 of this Declaration was the first application made in a Convention country in respect of the invention the subject of the application.

DECLARED at Lyon, France.

this 22nd day of March, 19 91

AU9174148

(12) PATENT ABRIDGMENT (11) Document No. AU-B-74148/91
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PROCESS FOR THE STERILISATION OF CONTAMINATED WASTE AND DEVICE FOR CARRYING OUT THE SAME

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(56) Prior Art Documents
GB 2130060
FR 2078203

(57) Claim

1. Process for the sterilisation of contaminated waste, characterised in that it consists in crushing the contaminated waste in order to obtain a mixture of uniform particle size, passing the crushed mixture onto a conveyor (12), levelling the mixture to obtain a layer of predetermined thickness on the conveyor and displacing the mixture by means of the conveyor at a determined speed, in order to perform the irradiation of the layer of waste through the field of an electron beam (15).

2. Sterilisation process according to Claim 1, characterised in that it consists in passing the mixture of contaminated waste to the upstream end of a conveyor (12) performing the displacement of the waste under the beam of an electron field (15) and permitting the evacuation thereof from its downstream end to the exterior.

3. Device for carrying out the process according to either ~~one~~ of Claims 1 and 2, characterised in that it comprises a processing chamber (3) within which there is situated a crusher to reduce the contaminated waste to a

.../2

mixture of uniform particle size, a conveyor (12), a levelling means (13) to obtain a layer of regulated thickness of the mixture of waste and an electron accelerator (16) to irradiate and to sterilise the layer of waste ~~(3)~~.

644420

Form 10

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952-69

COMPLETE SPECIFICATION

(ORIGINAL)

Class Int. Class

Application Number:
Lodged:

Complete Specification Lodged:
Accepted:
Published:

Priority :

Related Art :

Name of Applicant : JEAN LOUIS EMILE ROUX

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Address for Service : WATERMARK PATENT & TRADEMARK ATTORNEYS.
LOCKED BAG NO. 5, HAWTHORN, VICTORIA 3122, AUSTRALIA

Complete Specification for the invention entitled:

PROCESS FOR THE STERILISATION OF CONTAMINATED WASTE AND DEVICE FOR CARRYING OUT THE SAME.

The following statement is a full description of this invention, including the best method of performing it known to :- us

PROCESS FOR THE STERILISATION OF CONTAMINATED WASTE AND DEVICE FOR CARRYING OUT THE SAME

The present invention relates to a process for the sterilisation of contaminated waste and to a device for carrying out the same.

Contaminated waste is understood as referring to any waste which is biologically contaminated (that is to say contaminated by a source other than that originating from nuclear radiations) which, by reason of its nature, must be made up in special containers in order to prevent the mixing thereof with the other waste referred to as ordinary waste and evacuated with a view to the processing thereof and to the disposal thereof within a maximum period of 48 hours.

Thus, contaminated hospital waste or again waste which has been designated by the legislation by the term "specific" and classified in the second category (in contrast to the ordinary urban waste classified in the first category) is constituted by any medical or non-medical object which has been in contact with a patient afflicted by a serious infectious disease, such as, for example, AIDS, hepatitis B etc., and such waste must undergo these processings.

To do this, a process for the disposal of this waste consists in burying it in monitored dumps after it has undergone a previous processing. It is thus stacked in various layers which are each covered in succession by disinfectant and degradation chemical agents. As will be appreciated, this process exhibits the disadvantages of degrading the natural environment of the site on which it is carried out as well as of polluting the groundwater tables by infiltration.

In order to remedy these disadvantages, it is known to have recourse to the incineration of this waste in furnaces, the temperature of which exceeds 1100°C in accordance with the specified standards.

Now, it emerges that generally these incineration furnaces do not comply with the regulations, and

especially that they are not suitable for achieving such temperatures. Furthermore, the combustion residues (ash, unburnt residues, fumes) do not always undergo a specific reprocessing and, as a result of this, are significant carriers of pollution and of contamination. Finally, the combustion fumes released in the course of the incineration of this waste are frequently not filtered; this is another source of nuisance and of atmospheric pollution.

In order to avoid these various pollutions, and the contamination hazards which they create, centralised units for the processing of this waste have been employed. Nevertheless, on account of the high cost of their operation and of their construction, on sites which are far away from the sources of this waste, such units have simply remained at the stage of small experimental units.

Now, the development of "disposable" medical products as well as that of the infectious diseases have given rise to an increase in the volume of medical waste, and especially of specific waste. This is the reason why a process has been developed for the processing of this waste in mobile units, causing it to undergo a heat treatment by passing over a succession of microwave generators.

Nevertheless, although exhibiting the advantage of being capable of being used on various sites, such a process exhibits the disadvantage, on the one hand, of involving complex maintenance and, on the other hand, of permitting only a reduction in the number of germs per gram which this waste contains to a threshold within the range between 10^{-2} and 10^{-3}, that is to say corresponding to their decontamination.

The object of the present invention is to remedy these disadvantages, providing a process for the sterilisation of contaminated waste, which process permits a reduction to a threshold below 10^{-6} of the number of germs per gram which such waste contains. Furthermore, a device for carrying out this process has the object of preventing any external contamination.

To this end, this process for the sterilisation of contaminated waste consists in crushing the contaminated waste in order to obtain a mixture of uniform particle size, passing the crushed mixture onto a conveyor, levelling the mixture to obtain a layer of predetermined thickness on the conveyor and displacing the mixture by means of the conveyor at a determined speed, in order to perform the irradiation of the layer of waste through the field of an electron beam.

By virtue, on the one hand, of the crushing of this waste into a mixture of particles of small dimensions of particle size within the range between 1 and a plurality of cm and, on the other hand, of the levelling of this mixture of contaminated waste to form a layer of regular thickness within the range between 1 and a plurality of cm, this sterilisation process permits the achievement of a good sterilisation of this waste under the field of an electron beam, on account of the fact that the irradiation dose is controlled, being aware of the transport throughput of the crushed waste, the thickness of the layer of waste and the characteristics of the electron beam.

This sterilisation of the waste then permits the processing thereof in the manner of waste referred to as ordinary.

According to a beneficial feature of the invention, this process consists in depositing this mixture of contaminated waste at the upstream end of a conveyor performing the passing of the waste under the field of an electron beam and permitting the evacuation thereof from its downstream end to the exterior.

Advantageously, this process consists in performing the passing in a discontinuous manner of the waste within a sealed container, causing the waste to fall by gravity into a crusher and evacuating this mixture of contaminated waste, by gravity, continuously and in a regulated manner, on the upstream end of the conveyor.

According to a beneficial feature of the invention, a device for carrying out the process comprises a

processing chamber within which there is situated a crusher to reduce the contaminated waste to a mixture of uniform particle size, a conveyor, a levelling means to obtain a layer of regular thickness of the mixture of waste and an electron accelerator to irradiate and to sterilise the layer of contaminated waste.

Advantageously, a belt conveyor is intended to cause the layer of contaminated waste to move from its upstream end to its downstream end.

This conveyor, the width of which is substantially identical to that of the field of the electron beam, permits a regular conveying of this waste. Furthermore, it comprises lateral edges to prevent any undesired falling of particles of this mixture of contaminated waste.

According to a beneficial feature of the invention, the electron accelerator comprises a cell within which an electrical insulating gas pressure prevails as well as an accelerator tube generating an electron beam of energy within the range between 1 and 3 mega-electron volt and a scanning device comprising at least one magnet generating a magnetic field and terminating in a window separating the vacuum zone from the atmosphere.

This electron accelerator generates an electron beam of energy within the range between 1 and 3 mega-electron volt which permits a uniform sterilisation and irradiation of the layer of mixture of waste by an irradiation dose within the range between 10 and 50 kilo-Gray.

Advantageously, the processing chamber is arranged to be disposed on a vehicle.

This permits the setting-up of this device on various sites. It is thus possible to process in situ the contaminated waste originating from hospital establishments of small and medium size; this enhances the capacities of application thereof.

In any event, the invention will be well understood with the aid of the description which follows, with reference to the accompanying diagrammatic drawing,

representing by way of non-limiting example an embodiment of this device.

Figure 1 is a very diagrammatic view, in longitudinal cross-section, of the entire device.

Figure 2 is a view, in transverse cross-section, representing more particularly the electron accelerator.

As is best illustrated in Figure 1, this device comprises an articulated arm 1, which permits the gripping and the introduction of a container 1 into a chamber 3. Within this container 2, there is situated biologically contaminated waste originating essentially from hospital establishments. By reason of its specific nature and of its origin, this waste is made up in special containers and must be disposed of within 48 hours.

This articulated arm 1 is arranged to permit the elevation of the container 2 as far as an entrance opening, not shown, provided in the upper end of the chamber 3 and the discharge of this container 2, after opening thereof and rotation thereof through 90°, into a sealed hopper 4. This hopper 4 is closed by a cover 5 which opens in the course of the introduction of the container 2 into the chamber 3 and which closes again after the removal of this container 2 outside this chamber 3.

The lower end of this hopper 4 comprises an orifice which can be obturated to a greater or lesser extent by a trap 6. The contaminated waste introduced in a discontinuous manner into this hopper 5 falls by gravity in a continuous manner and in accordance with a regulated throughput, and passes out into a crusher, not shown, which is situated below this opening within a crushing chamber 7. This crusher reduces to a mixture of uniform particle size consisting of small particles of dimensions within the range, for example, between 1 and 3 cm and preferably between 1 and 1.5 cm, this heterogeneous waste consisting of various textile and plastic materials, of metal, of glass, of paper... This crushing chamber 7 opens out into a container 8 into which falls, by gravity, the mixture of contaminated waste and in

which it is temporarily stored. The lower end of this container 8, in the form of a cone 9, comprises an orifice 10 which can be obturated to a greater or lesser extent by a trap 11 situated above the upstream end of the belt conveyor.

The mixture of contaminated waste falls, by gravity, onto the belt conveyor 12, in accordance with a throughput regulated by the trap 11. A scraper 13 situated downstream of this orifice 10, above the conveyor, at a predetermined distance from the latter, permits the levelling of this mixture of contaminated waste to form a layer of regular and quasi-constant thickness within the range between, for example, 1 and 3 cm and preferably between 0.5 and 1.5 cm.

The belt conveyor 12, of length within the range between 2 and 4 m, is driven by known means (not shown). It comprises, on each side, a lateral edge 14 in order to prevent any falling of contaminated waste and possesses a width substantially identical to that of the field of the electron beam 15 emitted by a scanning device 18 associated with an electron accelerator 16, as represented in Figure 2.

This electron accelerator 16, of a known type, comprises a cell 17 within which there prevails a pressure of an electrical insulating gas and in which there is situated an accelerator tube 26, under a high vacuum generated by a pumping device 27 of a known type. This vacuum permits the promotion of the path of the electron beams, of energy within the range between 1 and 3 mega-electron volt and preferably of 2.2 mega-electron volt from this accelerator tube 26 to a scanning device 18.

The scanning device 18 comprises an electromagnet which generates a magnetic field which permits the deflection of the electron beam and terminates in a window which separates the high-vacuum zone from the atmosphere. The field of the electron beam 15 readily passes through this window and it irradiates and sterilises for a period of approximately one to two minutes the layer of mixture of contaminated waste, which layer is

disposed on the belt conveyor in the course of the passage thereof under this field 15. In order to obtain a sufficient irradiation dose, this period of irradiation may vary as a function of the nature of the waste to be sterilised, by simple regulation of the speed of movement of the belt conveyor 12. The irradiation dose delivered is within the range between 10 and 50 kilo-Gray and is sufficient to sterilise this contaminated waste, that is to say to obtain a number of germs per gram which it contains which is below 10^{-6}.

This irradiation is performed by scanning by a field of an electron beam 15 or scanning cone having a width within the range between 0.6 and 1 m, of which the axis of the field of the beam 15 is directed perpendicularly to the direction of displacement of the belt conveyor 12. The distance separating the end of the field of the beam 15 from that of the conveyor 12 is defined and regulated as a function of the nature of the products to be sterilised.

In order to prevent any heating of the electron accelerator 16, there is provided a closed cooling circuit in which a fluid such as water circulates.

It is thus entirely feasible, after a specific and appropriate regulation, that the axis of the field of the electron beam 15 forms an angle with the perpendicular to the direction of displacement of the belt conveyor 12; this permits the creation of a larger irradiated surface area of the layer of mixture of contaminated waste.

This layer of mixture of irradiated waste is sterilised and conveyed to the downstream end of the belt conveyor 12, which end is disposed above a receiving chute 21 disposed at the upstream end of a screw conveyor 20. This layer of sterilised waste falls by gravity into this receiving chute 21 and this sterilised waste is conveyed and evacuated to the exterior of the chamber 3. It is poured out into a receiving container 25 to be then reprocessed either by incineration or by deposit in a dump in the manner of waste referred to as ordinary

waste.

This entire device is regulated and controlled from, for example, a programmable automatic system which controls the introduction of the contaminated waste in a discontinuous manner into the sealed hopper 4 in the chamber 3, as well as, on the one hand, the greater or lesser degree of opening of the traps 6, 11 and, on the other hand, the speed of advance of the belt conveyor 12 and the period and the dose of irradiation of the layer of mixture of contaminated waste.

In order to permit a manual control, from the exterior of the chamber 3, this automatic system is connected, for example, to a portable remote control cabinet comprising warning lights which indicate the correct operation of the various electrical and/or electromechanical components of the device.

The protection against the radiations emitted by the electron accelerator 16 is provided by concrete, a thickness sufficient to take account of the primary and secondary effects of these radiations. Thus, in order to prevent an emission of X-rays outside the chamber 3, the latter is constructed by the stacking of rubble stones of concrete of sufficient thickness. When this is possible, this chamber 3 may take account of the configurations of the site on which the device is used.

The indication of the presence of this device and of its operation is in compliance with the regulations in force, in order to prevent any risk of contamination of persons. In particular, it comprises an indication of the radiation level which prevails at various points of greater or lesser distance from the zone of operation of this device, as well as a light signalling from panels prohibiting access on the part of any unauthorised person to this zone.

In another embodiment of this device, the chamber 3 is arranged to be disposed on an appropriate vehicle, such as a semi-trailer platform. This permits the capability of sterilising the contaminated waste on various sites and especially in hospital or similar establishments

of small or medium size. It will be appreciated that this permits a considerable increase in the capacities for application of such a device.

In order to prevent any loss of space within the chamber 3, disposed on a vehicle, the electron accelerator 16 is displaceable between two positions about an axis of rotation 29. A first position, which is the operating position, in which it is disposed as shown in Figures 1 and 2, vertically perpendicularly to the direction of advance of the belt conveyor 12, and a second position, obtained after a rotation through 90°, which is the transport position, in which it is disposed horizontally parallel to the direction of advance of the belt conveyor 12.

Likewise, in order to facilitate the setting up of all the elements of the device within the chamber 3, the screw conveyor 20 is formed of foldable modular elements which are assembled, as a function of the configuration of the site on which this device is used. This assembly permits the creation of a sufficient length of screw to obtain the discharge of the sterilised waste into the receiving container 25.

In this embodiment, the protection against the radiations of the electrons is obtained by a cell made of concrete, on the receiving site, and within which there is removably accommodated the platform of the semi-trailer on which this chamber is disposed.

In another embodiment, a radiological protection chamber 28, as represented in Figure 2, entirely surrounds the cell 17 of the electron accelerator 16. This protection chamber 17 is constructed from concentric layers of lead and/or of steel, of suitable thickness to prevent all the radiations emitted by the electrons as well as the primary and secondary effects which they cause.

It will be appreciated that this process for the processing of contaminated waste and this device for carrying out the same, which are available in a form which is compact, has a low energy consumption and

capable of being transported, permit the resolution of the problems posed on the one hand by the development of the so-called disposable products as well as that of the infectious diseases which involves an increase in the medical waste referred to as specific and, on the other hand, by the progressively increasing percentage of this specific waste which cannot be sterilised by a processing in an autoclave as well as the limitation of the use of the sterilisation by a processing using ethylene oxide.

As is self-evident, the invention is not limited only to the embodiment of this device for carrying out the process for the sterilisation of contaminated waste which has been described hereinabove; on the contrary, it covers all the variants thereof respecting the same principle.

Thus, there will be no departure from the scope of the invention by the use of other means for conveying the waste, such as a supporting surface driven to execute a vibratory movement, of other means for controlling the regulation, as well as by an adapted regulation of the distance between the field of the electron beam and the belt conveyor permitting a sterilisation of various objects intended for different applications, such as a central sterilisation in a hospital environment, by the use of means for levelling the layer of waste which are formed by a roller or vibrator calibrator, or again by the use of a conveyor for the evacuation of the waste from the conveyor other than an endless screw.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

CLAIMS

1. Process for the sterilisation of contaminated waste, characterised in that it consists in crushing the contaminated waste in order to obtain a mixture of uniform particle size, passing the crushed mixture onto a conveyor (12), levelling the mixture to obtain a layer of predetermined thickness on the conveyor and displacing the mixture by means of the conveyor at a determined speed, in order to perform the irradiation of the layer of waste through the field of an electron beam (15).

2. Sterilisation process according to Claim 1, characterised in that it consists in passing the mixture of contaminated waste to the upstream end of a conveyor (12) performing the displacement of the waste under the beam of an electron field (15) and permitting the evacuation thereof from its downstream end to the exterior.

3. Device for carrying out the process according to either ~~one~~ of Claims 1 and 2, characterised in that it comprises a processing chamber (3) within which there is situated a crusher to reduce the contaminated waste to a mixture of uniform particle size, a conveyor (12), a levelling means (13) to obtain a layer of regulated thickness of the mixture of waste and an electron accelerator (16) to irradiate and to sterilise the layer of waste ~~(3)~~.

4. Device according to Claim 3, characterised in that the conveyor (12) comprises an endless element, such as a belt or a chain driven to execute a displacement movement.

5. Device according to Claim 3, characterised in that the conveyor comprises a supporting surface driven to execute a vibratory movement intended to perform the displacement of the waste.

6. Device according to Claim 4, characterised in that the means for levelling the mixture of contaminated waste to form a layer of regular thickness are constituted by a scraper (13) disposed above the conveyor at a determined distance from the latter, between the zone of passage of the waste and the irradiation zone.

7. Device according to Claim 3, characterised in that the electron accelerator (16) comprises a cell (17) within which an electrical insulating gas pressure prevails as well as an accelerator tube (26) generating an electron beam of energy within the range between 1 and 3 mega-electron volt and a scanning device (18) comprising at least one magnet (19) generating a magnetic field and terminating in a window separating the vacuum zone from the atmosphere.

8. Device according to Claim 7, characterised in that the axis of the field of the electron beam (15) emitted by the scanning device (18) is perpendicular to the direction of displacement of the waste on the conveyor (12).

9. Device according to Claim 7, characterised in that the axis of the electron field (15) emitted by the scanning device (18) forms an angle with the perpendicular to the direction of displacement of the belt conveyor (12).

10. Device according to any one of Claims 3 to 9, characterised in that it comprises a sealed hopper (4) to receive the contaminated waste, below which hopper there is disposed a crusher reducing this waste to a mixture of uniform particle size, which mixture is temporarily stored within a sealed container (8) disposed below the crusher, and the lower end of which comprises an orifice (10) which can be obturated to a greater or lesser extent by a trap (11) disposed above the upstream end of the conveyor (12).

11. Device according to any one of Claims 3 to 10, characterised in that the downstream end of the conveyor (12) is disposed above the upstream end of a conveyor (20) for the evacuation of the sterilised waste to the exterior.

12. Device according to Claim 11, characterised in that the conveyor (20) disposed at the downstream end of the conveyor is an endless screw mounted on an articulated support and formed of assembled modular elements.

13. Device according to any one of Claims 3 to 12,

characterised in that it is mounted within a chamber (3) equipped with means for protection against the radiations emitted by the electrons.

14. Device according to Claim 13, characterised in that the means for protection are formed by a radiological protection casing (28) surrounding the cell (17) of the electron accelerator comprising at least one layer of protective materials such as steel or lead, and by concrete participating in the composition of the walls of the chamber (3).

15. Device according to Claim 14, characterised in that in the case where the cell (3) is mounted on a vehicle the cell is intended, under conditions of processing of the waste, to be accommodated within a fixed cell made of concrete.

DATED THIS 5th day of April, 1991

JEAN LOUIS EMILE ROUX

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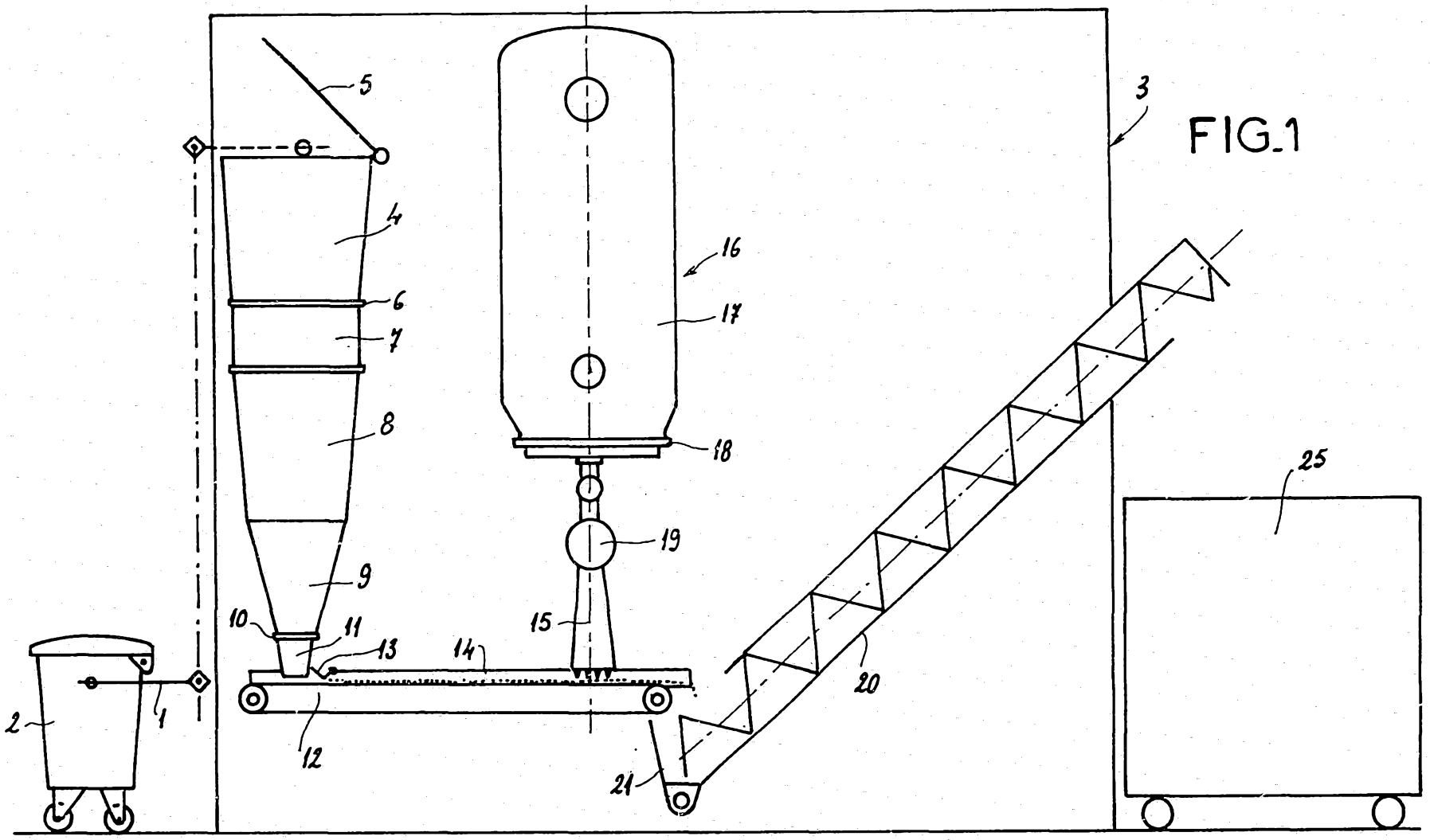

FIG_1

FIG.2