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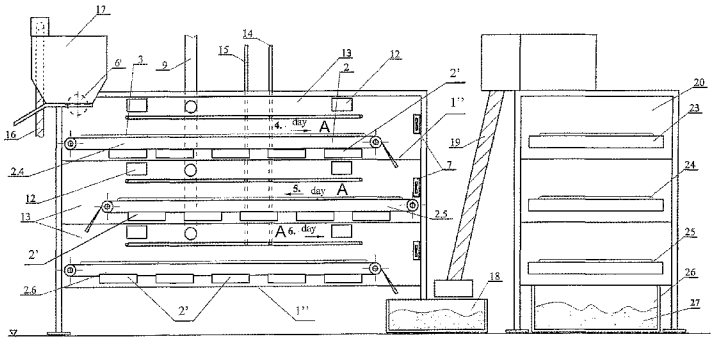
(54) **Title:** DEVICE FOR PRODUCTION AND SEPARATION OF BIOHUMUS



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(57) **Abstract:** Device for production and separation of biohumus, consists from a housing (1) of the device with three conveyor belts (2.1), (2.2) and (2.3) set one underneath the other and three conveyor belts (2.4), (2.5) and (2.6) in the housing (1') all of these set in special tunnels (13) with heated air. Housings (1) and (1') are set in parallel, one next to the other, where dung (3) is dosed by dosage units (6) and (6') onto the conveyor belts, and underneath the belt (2.6) of the second housing (1') wherein is set a collecting container (18) that is connected to a vibratory dumping out grating (20) by means of a worm conveyor (19). At the entrance of the first housing (1) above the conveyor belt (2.1), is set a receiving compartment (4) with a mixer, a heater and a dosage unit. Above the receiving compartment (4) is set a conveyor (5) to bring the dung therewith. Belts of the conveyor belts (2.1) to (2.6) have rubber deflectors (2') shaped as a turned up letter "V" that are set at certain distances along the whole length of the belt and for the purpose of removal of the migrating larvae and the rest from the floor (1") of the tunnel (13), by cleaning aside the migrating larvae and the rest from the floor (1") and toward the lateral collector (22). At the top of the dumping out grating (20) for separation of fractions of biohumus, a coarse-grained sieve (23) is set for the first fraction of biohumus - matters granulated without larvae, and a middle sieve (24) set underneath it, for the second fraction - matters for granulation and larvae, while underneath it is a fine sieve (25) for the third fraction - pure biohumus (27).

WO 2008/040033 A2

DEVICE FOR PRODUCTION AND SEPARATION OF BIOHUMUS

TECHNICAL FIELD OF INVENTION

Invention belongs to the devices for production of biohumus, and for development and/or breeding of synantropic flies by selective separation, as well. Invention also belongs to the devices for separation of solid materials by using a sieve, and respectively by application of vibratory tables - dumping out gratings.

According to the seventh edition of the International Patent Classificaton, the invention is classified and alloted by classification symbols : A 01 K 67/033 and B 03 B 4/02.

TECHNICAL PROBLEM

Technical problem solved by herewith described invention consists of the following:

- how to make an economic and compact device wherein, by means of effect of larvae of synantropic flies, three fractions of biohumus would be obtained, where minimal dissipation of larvae will be provided, as well as collecting of as much larvae as possible from the floors of the tunnel of both housings of the device, for the purpose of production of as large quantity of pure biohumus as possible;
- how, by means of a vibratory device to provide taking out (separation) of fractions of organic manure and pure biohumus in industrial production.

STATE-OF-ART

State-of-art according to the definition refers to the existing practical solutions in the above mentioned state-of-art whereto the referred invention belongs. Worldwide exist different plants and devices for production of organic manure from dung, but this inventor who is a coauthor of one of those patents, and a co-author of a domestic utility model YU782 MP titled

as „Device for Granulation of Material" is not informed that a device for production of biohumus with minimal dissipation (loss) of larvae through industrial production of organic manure with separation of fractions of biohumus has been made so far.

Utilization of waste by means of cultivation of larvae of flies at the wastes (faeces) provides that the wastes in up to five to six 24 hour cycles (24 hour cycles hereinafter will be referred as day 1, day 2, day 3, etc.) transforms into the organic manure and biomass. Realization of such a device in industrial proportion demands elaboration of a series of technical solutions and these regarding three aspects: 1) creation of efficient functional plants and devices for processing of dung (a cultivator of fly larvae), 2) formation of efficient functional insectaria for obtaining a stable laying down place by a mother family of synantropic flies, and 3) providing maximal production of biohumus.

Considering the cycle of development from an egg up to a predoll (that at the temperature of 30°C amounts up to five to six 24 hour cycles), larvae weight increases at least by 300 times. Thus, it is purposeful to apply cultivation into two phases: on the substrate for laying down places 0.5 to 2, 24 hour cycles in thermostat along with air ventilation, and onto the dung 3.5 to 5, 24 hours cycles in cultivator (according to the patent RF No.2049389, class A 01 K 67/033, 1992). This enables that the degree for utilization of the equipment is higher at 1.1 up to 1.6 times. Continuation of the technical solution that is directed as a standard laboratory substrate is a solution according to the patent RF No. 2088080, class A 01 K 67/033 oriented onto the natural substrate (dung) that proves appropriateness of application of cultivation into two phases.

At each laying down of dung onto the device, it is necessary to include optimally dosed quantity of eggs or the appropriate quantity of larvae of equal phase of development. That can be achieved by synchronization of dosage unit for dung and dosage quantity of substrate whereon are set larvae upon the first phase of cultivation, which had been solved by some solutions in the prior state-of-art.

It is recommended to use the instinct of migration characteristic for predolls i.e. instinct of withrawal from the matter that goes under processing, in view of the fact that it is easier to divide biohumus with migrating larvae than to take it out of the general bulk of two obtained products. Herewith, in biohumus remain some undeveloped larvae that die during later processing (granulation).

It is well known that the device for processing of dung by means of larvae of synantropic flies (patent RF No. 2032393, class A 01 K 67/033),

that involves a sector for processing of dung with trays set underneath and devices for vertical and horisontal shift, with knots for loading dung (faeces) into or loading off the processed matters, sector for flies and separator for larvae from the processed matter in the form of conveyor belt with a light source set onto it. Insectarium for flies that is set at the entrance of the chamber with a dosage unit for substrate and that is set at the entrance of the chamber, while inside the chamber are set conveyor belts between the entrance and exit, with possibility of setting the substrate for laying down for places on the belts. Herewith, above the conveyor belts are set the covers with outlets wherein are set valves for flies as vent apertures, where conveyor belts at the outlet of the chamber are connected by the knot of loading from the sector for processing of dung. The problem emerges when the larvae uncontrollably fall off the belt of the conveyor belt.

In the solutions shown in the prior state-of-art the problems of migrating larvae were not properly solved as their escape from the housings generates great losses in industrial production of organic manure. Herewith suggested solution of the device for production and separation of biohumus partially removes the disadvantages of the devices explained in the prior state-of-art according to the defined technical problem.

DESCRIPTION OF THE INVENTION

Compared to the solutions exposed in the prior state-of-art, herewith suggested solution of a device for production and separation of fractions of biohumus, has a compact construction with two parallel housings, set immediately one next to the other, where each of them has three conveyor belts that are vertically inset in the housing, one underneath the other, and all are set in closed tunnels, each one having its floor, for collecting the larvae.

Novelty of the invention essentially is in that that this device solves the problem of greater losses of larvae at their migration and allows separation of biohumus in industrial production of organic manure. With this solution of the construction of a device with two parallel housings with three tunnels, each one having its floor, in each housing. Novelty of the invention is in the application of he lateral collectors of larvae and fine biohumus along the whole length of the housing that solves the problem of the loss at migrating of larvae during industrial production of organic manure.

Further, the novelty of the invention is in its compact construction of the device where it is achieved so as that it comprises of a particular

housing with three belts (from day 1 to day 3) and a particular housing with three belts (from day 4 to day 6). A larvae collector is set underneath each belt on the floor of the the tunnel with the heated air. Novelty of the invention is in the construction of lateral collectors in the form of chutes for collecting the larvae and the fine biohumus that are set along the whole length of external lateral sides of both housings, herewith providing even greater quantity of biohumus in industrial production of organic manure.

Novelty of the invention is in its special construction of a part of a device in the form of a vibratory sieve - a dumping out grating with three sieves (coarse-grained, middle and fine) and the use of a collecting container set between a device for production of organic manure and a vibratory sieve for separation in the process of obtaining three fractions of biohumus: 1) - matters for granulation without larvae, 2) matters for granulation and the larvae, and 3) – pure biohumus.

DESCRIPTION OF THE FIGURES

Device for production and separation of biohumus, is thoroughly presented in the drawings where:

Fig. 1 - represents a device with both housings in the view from above,
Fig. 2 - represents a longitudinal cross section A-A of the first housing with belts for days from day 1 to day 3,
Fig. 3 - represents a longitudinal cross section B-B of the second housing with belts for the cycle from day 4 to day 6, with cross section of the vibratory dumping out grating,
Fig. 4 - represents a view of a belt of the conveyor belt, and
Fig. 5 - represents a view B of the second housing from the direction of filling with dung into the belt for day 4.

DETAILED DESCRIPTION OF THE INVENTION

Device for production and separation of organic manure from dung (biohumus), according to the invention and figures 1, 2, 3, 4 and 5 consists of a housing 1 of device with three conveyors belt 2.1, 2.2 and 2.3, set one underneath the other (for days from day 1 to day 3) and three conveyors belt 2.4, 2.5 and 2.6 in housing 1' (for days from day 4 to day 6) set in separate tunnels 13 with floors 1".

Belts of the conveyor belts 2.1 to 2.6 have rubber deflectors 2‘ shaped as a turned up letter 'V' - that are set at certain distances along the whole length of the belt and are used for removal of the migrating larvae and other, from the floor 1” of the tunnel 13, by cleaning aside the migrating larvae and the rest, from the floor 1” and toward the lateral collector 22.

At the entrance into the first housing 1, above the conveyor belt 2.1, on day 1, is set a receiving compartment 4 with a mixer, a heater and a dosage unit. Above the receiving compartment 4, is set a transporter 5 wherein dung is conveyed, being no novelty.

Both parts of the housing of the device 1 and 1‘ are completely closed by profiled sheet metals that are reinforced by metal boxes. Along the center of each device and on both sides of each tunnel 13, tubes 9 for drainage of oversaturated gasses extend. Endings of tubes 9 end in a joint biofilter 9’.

Next to the receiving compartment 4, and above the beginning of the belt 2.1 for day 1, is set a dosage unit 4’ for laying down of a single-day larvae into dung.

From one side of both parts of the housing 1 and 1’ are set a supply pipe 14 and a hot water exhaust pipe 15 for heating the dung in the tunnel 13, and immediately above all the conveyor belts 2.1, 2.2, 2.3, 2.4, 2.5 and 2.6 along the whole length of the transporter through the closed system 8 for heating by hot water. At the beginning of each tunnel 13 is set a fan 7 and the hot air flow of which is directed longitudinally above each belt (2.1 to 2.6) with dung 3.

At the end of each belt 2.1 to 2.6, a scraper 10 for cleaning the belt is set. At the bottom of each tunnel 13, a larvae collector 1” is set on the floor. Along both sides of each tunnel 13, at several spots, an aperture with a slide window 12 for type taking and visual inspection is set. Collecting container 11 for biohumus and larvae, upon day 3, is set under the scraper 10 of the third belt 2.3. From the collecting container 11 emerges a worm conveyor 16 up to the collecting compartment 17 with a dosage unit 6’ of biohumus and larvae that are set immediately above the begining of the belt 2.4, on day 4.

From both sides of both parts of the housing 1 and 1’ in the level of larvae collector 1”, achieved in the form of a floor of the tunnel 13, there are along the whole length of the housing, lateral collector 21 of migrating larvae and lateral collector 22 for collecting larvae from the floor 1” of the tunnel 13, being a novelty in comparison with the state-of-art as it solves a part of already defined technical problem.

At the end of belt 2.6, on day 6, and below the scraper 10 is set a

collecting container 18 for biohumus and the remaining larvae. From the collecting container 18 and up to the vibratory dumping out grating 20, extends a worm conveyor 19 and they are set in the same line, coaxially with the housing 1' of the device. Vibratory dumping out grating 20 consists from, on the top thereof, set a coarse-grained sieve 23, in the middle below the coarse-grained sieve is a middle sieve 24, and at the bottom is a fine sieve 25 under which is set a container 26 for collecting the pure biohumus (27), being a novelty in comparison with the state-of-art as it solves a part of a defined technical problem.

Method of functioning of the device for production and separation of organic manure from dung (biohumus) is simple and derives obviously from the above mentioned.

Dung 3 is vertically shifted at the ending of the belt 2.1 for day 1, onto the transporter 2.2. for day 2, so that at the end of day 3, through the scraper 10, it shifts to the collecting container 11 for biohumus and larvae, already existing in the prior state-of-art. By means of the worm conveyor 16, biohumus is brought into the collecting compartment 17 with a dosage unit 6' of biohumus and larvae for belt 2.4, on day 4. Dung 3 is further vertically moved at the end of day 4 onto the conveyor for day 5, and therefore at the end of day 6, through scraper 10 it comes to the collecting container 18 for biohumus and the remaining larvae.

On all the belts from 2.1 to 2.6 and tunnels 13, larvae are separated through: on the floor 1", then through the lateral collector 21 of migrating larvae from belt and lateral collector 22 of larvae from the floor 1" of the tunnel 13. Herein is the novelty of the invention. Moreover, the novelty is the construction of the belt with rubber deflectors 2' being poured out in a single part with the belt in the form of the turned up letter "V" and that are set in the direction of moving the belt. These deflectors scrape along the floor 1" of the tunnel 13 by cleaning aside the migrating larvae and the rest, from the floor 1", and toward the lateral collector 22.

From the collecting container 18 for biohumus and the remaining larvae, by means of the worm conveyor 19, biohumus with larvae is brought to the coarse-grained sieve 23 (intended for the lagging unprocessed dung), onto the vibratory dumping out grating 20 for separation of fractions of biohumus being another novelty in comparison with the prior state-of-art. Hence, upon the first separation on the coarse-grained sieve 23 there remains the lagging unprocessed dung.

Further separation is carried out in the middle sieve 24 wherein remain kept matters that are to be granulated without larvae as the first fraction of the biohumus. Finally, separation is carried out in the fine sieve

25 whereon remain kept the lagging matters that are to be granulated and the larvae as the second fraction of biohumus. Upon the third separation and obtaining the third fraction, and under a fine sieve 25, there is the container 26 for collecting the pure biohumus 27.

One of possible ways for embodiment of the device for production of organic manure from dung with separation of fractions of biohumus, that results in a complete ecological device and compact construction, is with possibility of setting six conveyors into two independent but connected housings, hereby to save space and to enable accomplishment the described process for production of biohumus from dung, and by means of larvae of the synantropic flies.

Two parts of the housing of the device 1 and 1' are made from profiled sheet irons that is reinforced by a metal box and adjusted for these needs. Conveyor belts 2.1 in this case is used for laying down dung for the processing – production of biohumus. Length of the conveyor depends on the daily quantity of the dung and it is adjusted so as to accept all the daily quantity of the dung. In each housing of the device there are three belts and each one is intended for a day for processing, and since the processing is done during six days (six 24 hour cycles) the whole device has 6 conveyor belts.

Dung 3 (pigs or poultry) is a raw material taken into the process of processing, i.e. production of biohumus. It has to have similar quality from day to day: moisture, chemical composition, i.e. type of food taken by the animals, etc. By conveying itself, the dung is homogenized - and equalized, i.e. brought closer to the optimum state for treatment by the larvae, i.e. processing.

Receiving compartment 4, a component part of which is a mixer and a heater with a dosage unit, it is used for receiving dung and preparation thereof and laying down onto the conveyor belt for processing; preparation comprises of mixing, and if necessary warming up and moistening. It is driven by an electric motor by a reducer, and its heating is done by the heaters by means of water. Worm conveyor 5 is used for conveying dung to the mixer of the receiving compartment 4 and usually is set under the angle of 60 to 70 DEG. Number of its revolutions per minute is 200 r/min.

Dosage unit 6 (i.e gate valve) is set at the bottom of the receiving compartment 4 (of the mixer) and its design is achieved to make it the component part of the dosage unit 6. It is used to dose up evenly the dung onto the conveyor belt 2.1 and to provide, at the same time, thickness and width thereto. Manipulation of dosage unit is manual, and it can be automatic. Dosage unit 6' for the mixture of biohumus and larvae is used to

place it evenly onto the belt for day 4 at the moment of shift from the belt for day 3. The receiving compartment 4 and the dosage unit 5 exist in the prior state-of-art.

Fans 7, set immediately above each conveyor belt, are used for ventilation and if needed for additional warming up in the tunnel. Controlled drying of the treated mass is achieved by air flow.

Closed pipeline system 8 for heating, by means of hot water, the tunnels 13 for processing, is set along the whole length above each conveyor belt.

Tubes 9, are used to exhaust oversaturated gasses that emerge from the procedure of processing (ammonia, formaldehyde).These gasses are exhausted into biofilter 9', being a separate construction, and it is a component part of the device. Biofilter is at the end of the device and it has to be supplied with waste gasses so as to provide that it functions well, and it has to be controlled for humidity and air flow. Thereby, a high ecological value of this device is provided. Construction of biofilter is a subject matter of an another patent of this inventor.

Scraper 10 for cleaning the belts of conveyor belts, is used so that the belt in departure is clean, and that the mass is evenly directed either onto the bottom belt or into the collecting container.

Collecting container 11 for biohumus and larvae upon day 3, is set underneath the scraper of the third belt 2.3 and receives all set on the belt (biohumus, larvae, waste and the rest that goes toward the the dumping out grating).

Outlet with a slide window 12 for taking types and visual inspection over the process is set laterally onto each housing; it enables to carry out visual inspection, during the processing, and moreover, if needed, as well, to take a type, being a novelty in comparison with the pror state-of-art, as well.

Tunnel 13 with heated air for processing consists from: from underneath a conveyor belt 2.1 up to 2.6, and from lateral side of a galvanized plate whereon are slide window 12 and from the top a cover – at the first and the fourth conveyor belt of the housings of the device, and along with other conveyor belts, the floor 1" under the tunnel is formed. Floors 1", from the both sides are ended by the collectors (21,22) for larvae.

Hot water pipe 14 for heating is achieved laterally along the middle of the device, by pipeline wherefrom two arms are divided per all three levels of one housing of the device. Water drain 15 for heating is achieved as with supply pipe but in reverse side.

Worm conveyor 16 is used for lifting mixture of biohumus and larvae from the bottom belt 2.3, on day 3 onto the upper belt 2.4, for day 4, more precisely into the collecting compartment 17 that has the dosage unit 6'.

Upon day 6, biohumus is lowered from the conveyor belt 2.6, on day 6, into the collecting container 18 for biohumus and the remaining larvae for further processing (separation of larvae). Worm conveyor 19 conveys biohumus from the collecting container 18 up to the vibratory dumping out grating 20, that represents a novelty in the construction of such devices in comparison with the prior state-of-art.

Preferred embodiments of this device anticipates that vibratory dumping out grating 20 has three sieves: a coarse-grained sieve, a middle one and a fine one. On the first level (sieve) remains all intended for no further processing (waste such as feather, foreign substances, dried dung that larvae cannot process) remains at the first level (sieve). Coarse-grained sieve 23 - has the diameter of holes of Ø 12 mm - and is used as a dumping out sieve for separation of waste from biohumus mass and the larvae and all that remains thereon is thrown away as it is for no further use. Middle sieve 24 - has diameter of holes of Ø 6 mm - and its role is to separate biohumus of the first fraction that goes forth to be granulated. Granulation is carried in the device for granulation of material that this inventor protected by a utility model no. YU 782 MP.

The first fraction that remains on the middle sieve has neither larvae nor dolls. Fine sieve 25 - has diameter of holes of Ø2 mm – that gives passage only to pure biohumus of small third fraction, and thereon remain the second fraction of biohumus of granulation 2-6 mm with larvae, dolls, etc.; such a content is additionally treated. Container 26 for collecting the pure biohumus (granulation of up to 2 mm) wherein collected is the third fracton pure biohumus 27 without larvae and dolls that remained on the third sieve. This fraction goes on toward drying, and then into the grinder.

Lateral collector 21 (in the form of chute) for collecting larvae from the belt at disturbing the larvae, and without this, larvae naturally go out through the lateral collector 21 appropriate for receiving thereof. Lateral collector 22 (also in the form of chute) for collecting larvae from the floor 1" of the tunnel 13 and with those larvae that crept under the belt. Lateral collector 22 is larger than the lateral collector 21 as it has one more function to collect quite fine biohumus carried out by the movement of larvae. That is the finest fraction of biohumus that can be taken out seprately, and it can be mixed with other fractions at the end of the process.

CLAIMS

1. Device for production and separation of biohumus, with vertically set conveyor belts 2.1 to 2.6 in the tunnels 13 whereon dosing is done by means of dosage units 6,6', of dung 3, that the housings 1,1' are set in paralel one next to the other, *is characterized by*, that the rubber deflectors (2') on the belts of the conveyor belts (2.1 to 2.6) touch the floors (1") of the tunnels (13), that along the whole length and from both sides of the housing (1,1') are set the little lateral collectors (21) and, underneath these, the large lateral collectors (22), that underneath the conveyor belt (2.6) of the second housing (1') is set a collecting container (18) that is connected to the vibratory dumping out grating (20) by means of the worm conveyor (19).

2. Device according to the claim 1, *is characterized by*, that the collecting container (18) for biohumus and the remaining larvae is set underneath the end of the conveyor belt (2.6), on day 6, and that from it, by a worm conveyor (19), biohumus with larvae goes onto the upper coarse-grained sieve (23) of a vibratory dumping out grating (20).

3. Device according to claim 1, *is characterized by*, that on the top of the vibratory dumping out grating (20) for separation of fractions of biohumus, is set a coarse-grained sieve (23) for the first fraction of biohumus, and underneath it there is a middle sieve (24) for the second fraction, while a fine sieve (25) is set underneath it, at the bottom of the vibratory dumping out grating (20) is set a container (26) for collecting the pure biohumus (27).

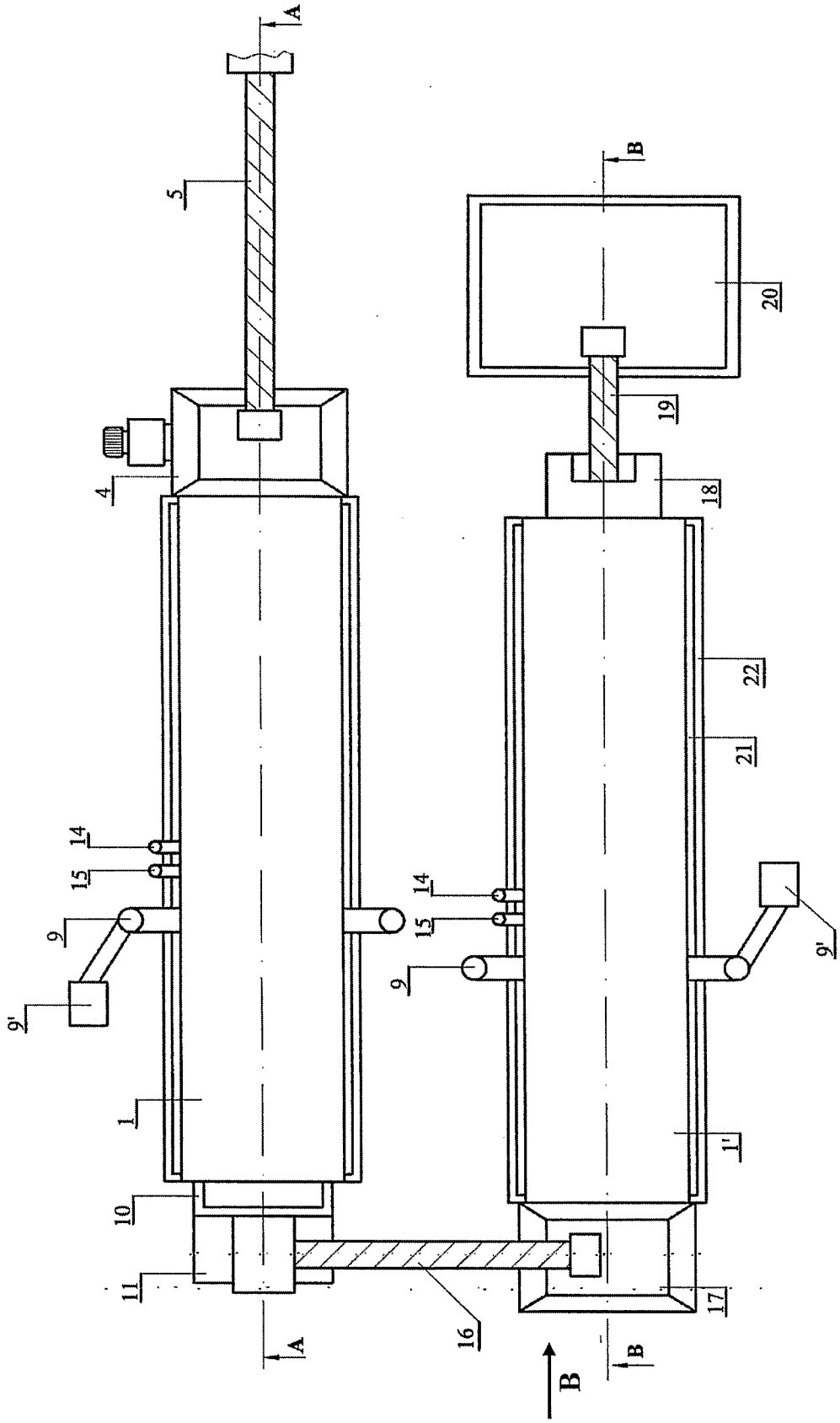
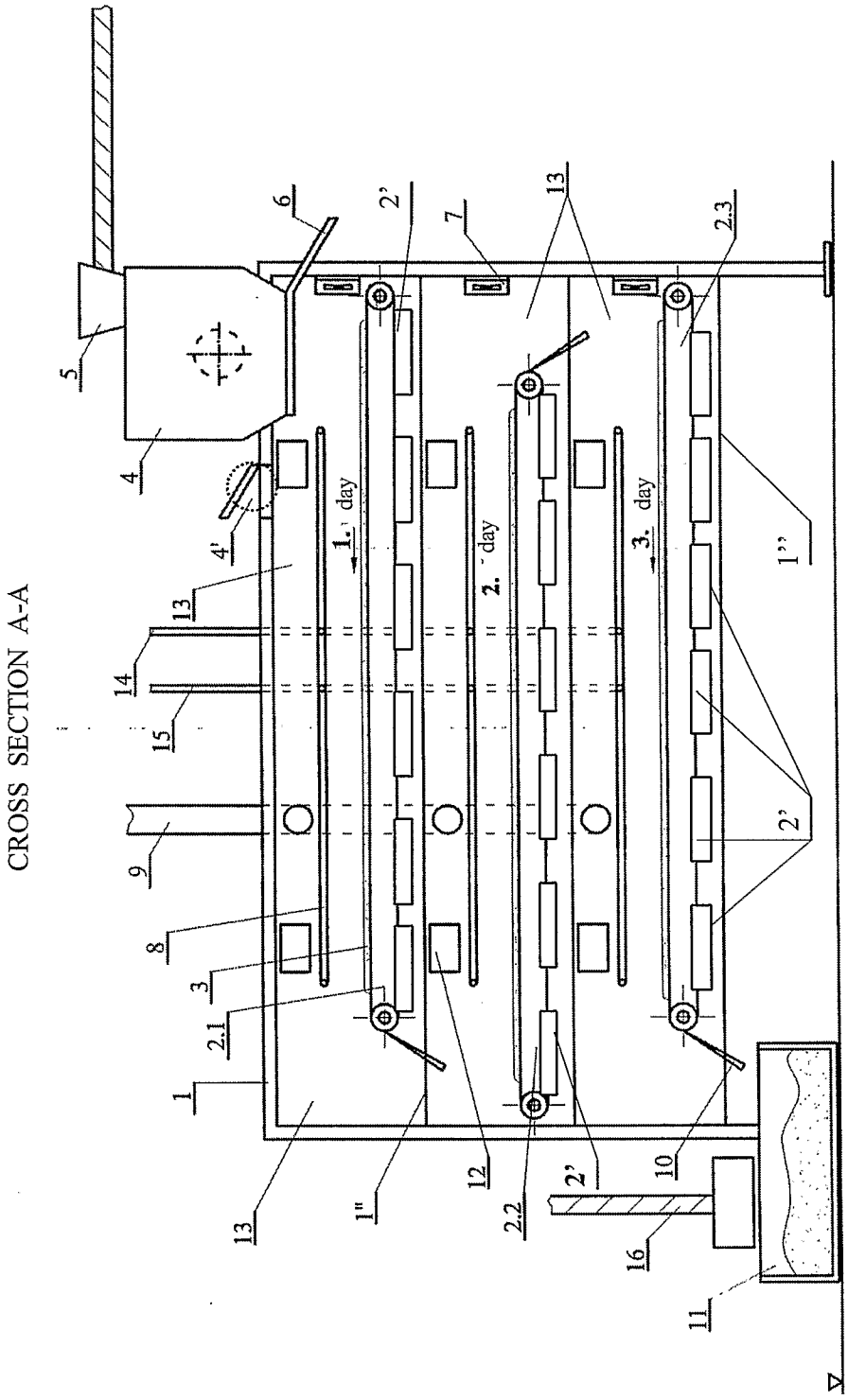


Fig. 1


CROSS SECTION A-A
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2. day
3. day
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1"
2'
2.1
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2.3
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4
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16

Fig. 2

CROSS SECTION B-B

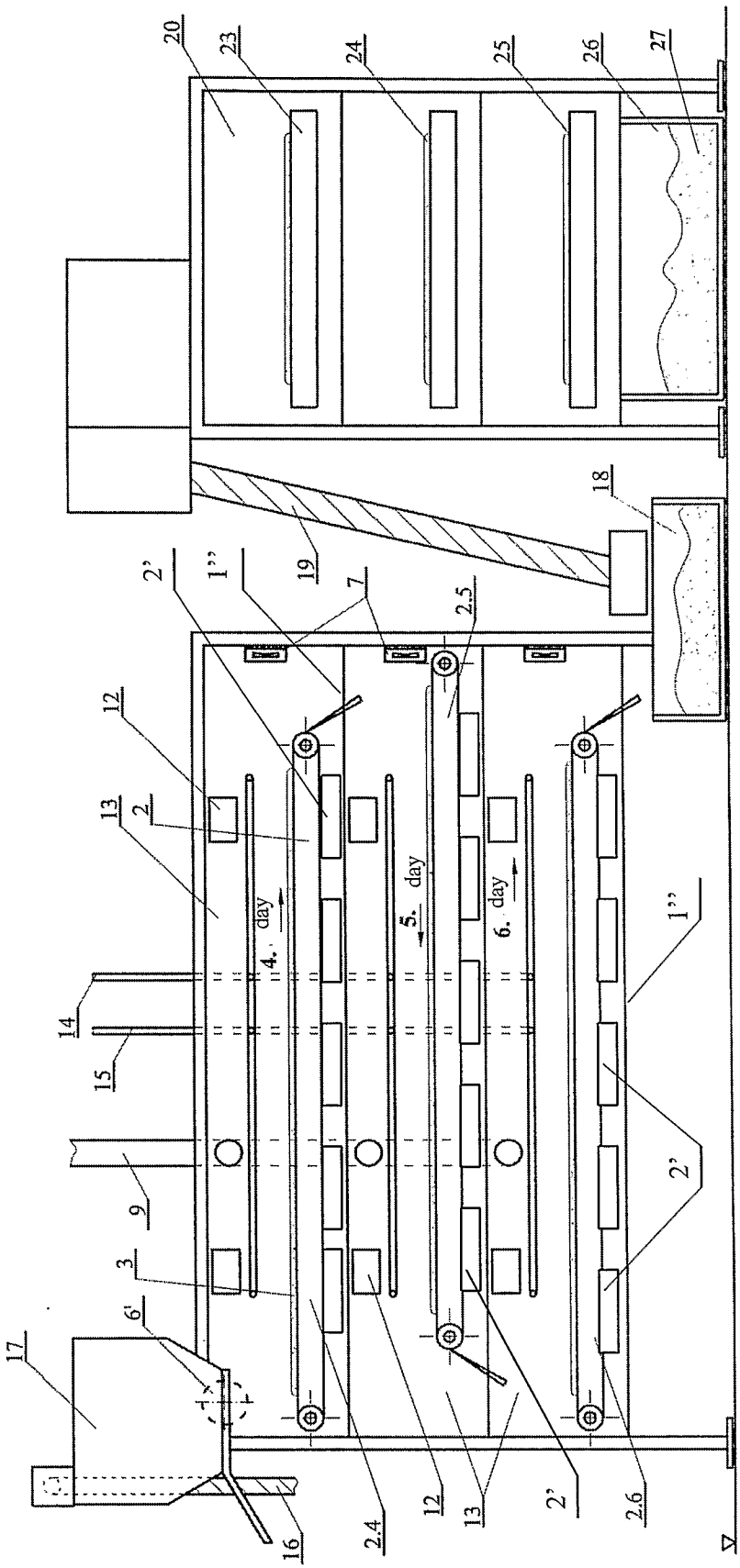

Fig. 3

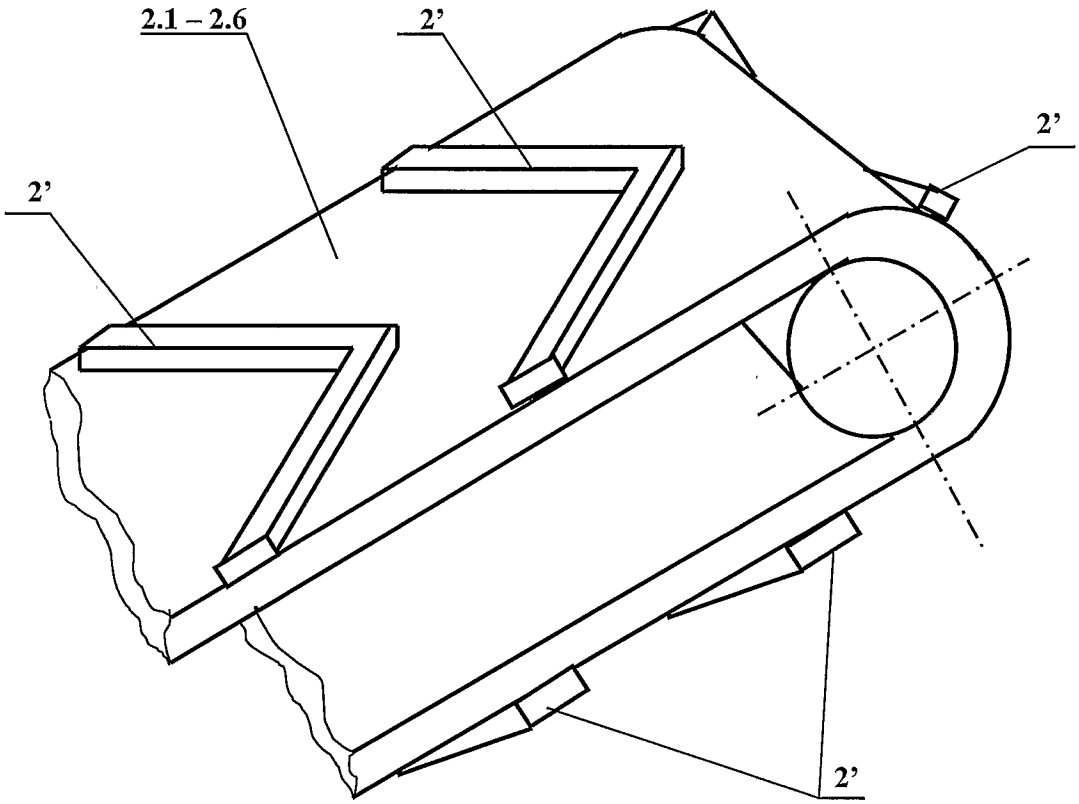

Fig. 4

VIEW B

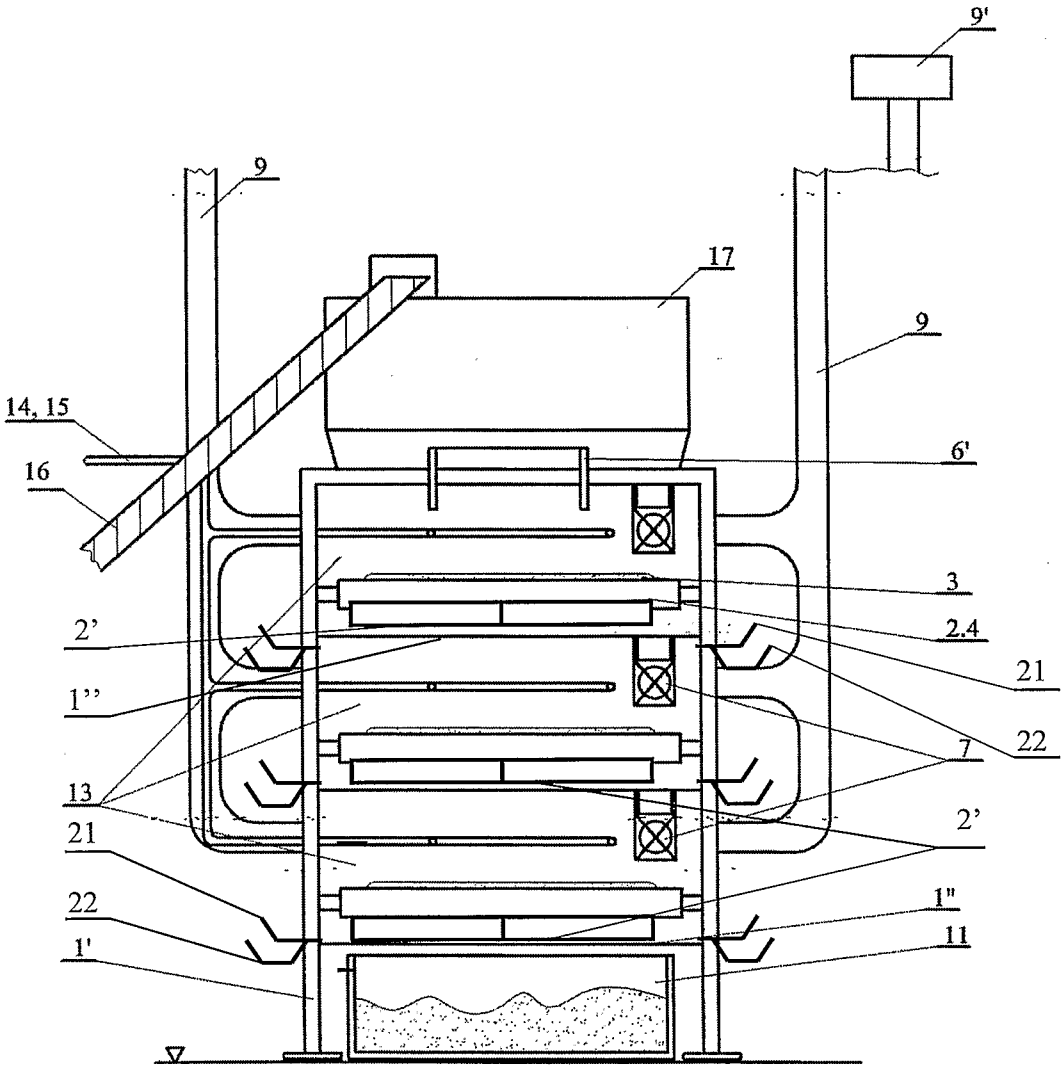

Fig. 5