# Linear synergistic system of digestion, dehydration and composting (LDCC)

Linear synergistic system of digestion, dehydration and composting (LDCC)

N. Demand PCTIT2013000315 – N. Patent WO2014/076725

Abstract

At the state of the art facilities and thermal power plants there are a major source of pollution of the atmosphere for toxic substances emitted and also a source of economic waste to the waste heat and not recovered. Today it is possible brings together technology equipment and materials so that we can recover resources and increase the yields of energy plants and water treatment plants that in the future as there will be one expanded facility that we can call GSPDPTC (global synergy plants for depuration, biomass production and thermoelectric cogeneration). Among the main components of these systems are the “linear digesters, dehydrators, composters” (LDDC). These synergistic systems compacting three processes into one, along with the biogas will produce compost in a long aerobic process that employs the same mesospheric digestion times. The sludge, without departing from the system, will be turned into quality compost dried, stabilized with calcium oxide and bagged. The LDDC, sized according to the energy recovered from waste water and gas, are the natural extension of the water line of the existing thermal plants as well as the recovery of chimneys and flue gas treatment (CCPC) are an extension of the “air”. In the process GSPDPTC complete these two lines the buildings synergistic vertical (VSB), vertical synergic buildings, containing limestone photosynthetic green house. Today, the thermal systems are not complete, not by closing the carbon

cycle anthropic nor by water or by air. Even the existing sewage treatment plants do not close the carbon cycle. Since the potential of thermoelectric plants are immense compared to those of the depuration GSPDPTC replace simultaneously thermal and purifiers, but without energy recovery allowed by (LDDC) and the production of biogas of high quality from these permitted in conjunction with the manufactured VSB, is not possible to realize these important environmental and energy innovations.

Description

**The technical field** of this inventionis environmental protection, the conservation of energy resources, the production of new clean energy. **This invention** belongs to a group of inventions that aim at preventing phenomena of water and atmosphere acidification and recovering of energetic resources, processes that cannot be carried out with current purification and energy production systems. The most important invention is the one that brings together in a single system old and new technologies so that nothing goes to waste. This main invention is named

(GSPDPTC): “Global synergy plant for depuration, biomass production and thermoelectric cogeneration”. This request is dedicated just to the digestion, dehydration and composting of biodegradable substances and does not enter into the merits of capture smokes and depuration processes that will be described in other industrial PCT requests connected in GSPDPTC system. But to use the entire system, there is need for many other existing technologies, in addition to those claimed. Only by integrating many technologies and many environmental applications it is possible to close anthropic cycles of carbon, nitrogen, phosphorous, recover and reuse the waste heat and CO2 in the environment.

**The background art** Protecting the environment, despite the advanced level of technological development available today, makes far less progress than is theoretically possible because the solutions used in the existing purification processes do not exploit the economies of scale that come with the concurrent use of water, air and lands, which can result in enormous efficiency gains in environmental protection. The energy production is considered a separate sector by sector purification, merely to comply with insufficiency of regulations, made to measure on a state of the art, especially in the heat sector, that prevents growing phase, not to shoulder burdens purification, which would reduce profits. However, the fear of shouldering these burdens, significant improvements have been neglected towards this field and have cause even heat that would lead to a doubling of energy efficiency to be failed in recovering the CO2 that could be used in favor of the environment. The chimneys are a shortcut that does not allow to address and solve serious environmental problems, since the combustion cycles, regardless of the fuel used, they can not terminate simply expelling the fumes into the atmosphere, but they must continue with other treatments, so that the environment is not contacted out by the dispelled missing toxic substances and pollutions but, at the same time they can be recovered resources such as heat and the CO2, which is the main greenhouse gas. The current state of the art allows a glimpse into the near future technologically advanced, such as the capture of CO2 from the environment by means of artificial trees, or by electrolytic and alkalization chemical (which has to do with the process of **alkalinizing water)** of large areas of marine waters, or directly in thermal power plants, with the so-called CCS that essentially are a chemical washing, which reduces the calorific value, capturing the $CO_2$, but it neutralizes, thus it is necessary to compress, liquefy and bury it about a thousand feet deep pockets to locate scrupulously because this solution can cause seismic hazards and dangerous gas leaks, known as ” Nyos effect” for a similar episode occurred in 1986 already found in several online publications. If it’s true that the petroleum is running out, it’s equally true that new techniques for the extraction of methane are extracting it from the ground in different forms (as shale gas and methane hydrates): for these reasons it’s not necessarily said that fossil fuels are endangered. At the same time, experimenting the biological energy production is making great strides both with crops from the fields (with or without GMO’s) and with the production of algal biomasses. However, this type of production can’t become sustainable if the industrialization of production continues to steal valuable land required for agricultural food production. Nevertheless, in this context whatever the energy of the future, the LDCC is inserted authoritatively solving the serious problems about the recover of the heat from the thermoelectric power plants and, plants that use the water for cooling. Suffice it to say that the most advanced thermal power plants do not arrive at the energy conversion efficiency of 40% compared to the lower calorific value of the fuel, waste incinerators that burn stop at 15 %, only plants with combined cycle turbines using light fuel and double (gas + steam) can get to that supernal yields 50%. Most of the energy is transformed into heat that is poured out into the water crossing only the plant to cool the components that would overheat, in particular turbines and condensers. A part of the heat is dissipated also in the fumes; the percentage depends on the type of heating system, which can also be a blast furnace, an incinerator or a cement plant which produces no energy. The recovery of the heat of the fumes and $CO_2$ are been treated in other PCT “requests”, while the LDDC touches the recovery of the heat contained in the water. The question here is, what better time have we got to produce biological energy at low cost, if we try always to lose out the opportunity in taking advantage of this great free source of energy supply, especially from power plants? But to take advantage of these great resources digesters do not suit, having very low digestive capacity – by this I mean the actual existing technology. It rarely exceeds one MWh of power while thermal power stations come to a capacity of 6,000 MWh (especially in

China). It is therefore necessary that the digesters become much more powerful and much smaller power plants to allow the heat and pollution that can be absorbed and be used in an appropriate manner to help the growth of the environment and the economy. The (LDDC), developed linearly, to be able to solve their own part of the problem, allowing linear paths to the heating pipes and many stations for loading and unloading of the material in exit and entry autonomously, that do not interfere with the production cycle of the other, while still using the same slurry digestion. This therefore makes the potential digestive to multiply in a way. Suffice it to say that a plant from 320 MWh will be able to feed twenty digesters linear with eleven stations for loading and unloading stations for a total of 220, which depending on the quality of the energy matrices included in the digesters can get to produce a quantity of biogas from a minimum of 30 % of the original central to a maximum that can greatly exceed the power efficiency of the plant. It is impossible to imagine the State of the art that with the existing digesters, wet, dry and semi- dry, we can achieve these results. They are not designed to be developed linearly, or to allow loading and unloading from above, neither to allow different loading stations in parallel. But the digesters are also famous for the odor they produce. Other bad  odors are been produced by the composting facilities to which the solid digestive is transferred; other problems produces them with the management of liquid digestive, also malodorous which must be purified , deodorized; another problem to solve is the quality of the biogas produced, which has a lot of the $CO_2$ that in the end does not produce a better quality and to even also have a calorific power satisfaction. These are all the problems that brilliantly solve the LDDC, which also incorporate the steps of dehydration and composting which are aerobic processes which follow immediately to anaerobic digestion. Some of the problems they solve them in the building (LDDC), others in the adjacent building (VSB), vertical limestone and photosynthetic green house (which will always be coupled) receiving air, $CO_2$

and liquid digestive expelled from (LDDC). The (VSB) as the (LDDC) do not exist in the current state of the art. The (LDDC) will therefore produce biogas very similar to the methane gas and compost directly stuffed into sacks draining, in a fully automated process and with closed ventilation that draws air from the outside environment but only expelled through the adjacent tall buildings (VSB), after it has been cleaned and deodorized by passing it through the limestone sections (vcmlg), which will also serve to neutralize the $CO_2$ and alkalize the water. So we should not think that the biological energy can be achieved by simply turning farmers into producers of energy, as some governments are wrongly encouraging this process. Farmers will never be able to recover all the heat, neither be able to recover the $CO_2$, nor purify and alkalize the water and even produce compost directly bagged or reduce odors that processes entail, nor produce crops with industrial processes with production capacity ten times higher of the surface area but if this is anyhow produced in a vertical order, we can be sure of talking of hundred times superior of the production capacity here. Even in the field of biological energies you can be sure of making the same mistake, already found out with the thermoelectric power, solar and wind power, funding the research and production instead of creating unemployment when new inventions, such as the present one, which has not yet received a single penny as a sort of encouragement, but it is based on fifteen previous patents of the applicant, which started with alternative purification systems, focusing on prevention of acidification and simultaneous purification of water and air These innovations could make a difference of several in connection to the actual state of the art, simply because today, who cleans up the air does not occupy with the cleaning up of the water and, vice versa; who treats the waste does not deal with energy, except for the few digest sludge produces, and those who produce energy does not bother to clean up the water and even to recover the heat and $CO_2$ for environmental purposes. The orientation of the state of the art goes in the opposite direction, towards the CCS systems, so it is fair to say that this system does make a quantum leap in the opposite direction. Before the global environmental authorities will ever understand that the CCS is not in the interests of the environment. It is a fortune that many major countries, like CHINA, INDIA are contrary to the CCS system, even if they continue to carry out thermal power plants up to 6000 MWh and produce steel in blast furnaces of very large, the heat of which will never be recovered from (LDDC), as the $CO_2$ can not be recovered and purified from the (VSB ) soot, if these countries do not review the size of the plants, the territorial position in which these are been produced, that supposing should be close to large bodies of water or the sea, and do not even combine the (CCPC) and (VSB). These large structural works could demonstrate that the production of clean energy can stand alone in the market, when compared with purified fossil energy, and purified industrial water thermal plants. Today, the comparison can not exist, because the current systems do not purify properly air, or water. It is not a complete air purification without neutralizing the $CO_2$ and water purification is not complete if you do not adjust the pH to that of the receiving water body. It means that as we get closer and closer to the sea and the rivers banks, they should also be purified and Alkalinized if we really want to fight ocean acidification. All this is still not understood and the air purifiers still emit $CO_2$ into the environment and to discharge acidic water, while environmental authorities just sit there trying to fight an un ended battle with words. Thermal power plants continue to produce together with the energy $SO_x$ $NO_x$ and $CO_2$ fine dusts. Any public or private entity has sufficiently studied the water purification and air together. But it is evident, without complicated calculations, that realizing synergistic systems, the recovery of the great resources today wasted would cover investments for environmental protection. But even if it weren’t so we cannot go forward with actual solutions that harm the environment and quality of life of men. From the recovery of heat and $CO_2$

there will be an economic boom of the future that will transform all sectors, industrial energy, agricultural and urban. The current and long routes of sewage sludge and the existing activated sludge treatment plants, involve a huge waste of resources, since they degenerate sewers and sewage treatment plants to regenerate consume a lot of energy for oxidation in open tanks that emit $CO_2$ and hydrogen sulfide in the atmosphere, which are transported by wind and water reabsorbed from the atmosphere and further contributing to acidification and global warming. The double sewer system shown in fig.7 (Gued), the global urban environmental depuration, manufactures water purification in the same urban area, capture the $CO_2$ and smog and transfers them to the ( VSB) that complete water purification and alkalize at the expense of $CO_2$ and calcareous material specially stored. But these buildings will also produce biomass energy with industrial systems that will be transferred to LDDC to produce biogas that feeds the same (TEPbio) without producing pollution, as with (CCPC) that feeds in the same way (VSB), which feeds a (LDCC) that returns the liquid digestive to reproduce biomass energy in a closed cycle and infinite that does not emit air pollution. The excesses of methane produced, may be placed directly in the network of urban consumption. The (TEP bio) Urban and the whole system, not been polluted, can be carried in the same city, or in the immediate vicinity, to prevent degenerative and expensive transport systems of sewage and biomass. The same (LDCC), which uses an anaerobic digester, known producer of odors is made harmless in this respect by the combination with a strong aerobic process of dehydration and composting, which expels the air only after purification through the conservatory limestone that works as a scrubber. But outside of urban centers we have to think big structural works, in which the new (LDCC) will play an even more central role. Of these works, there must be part some existing systems, such as (TEP) thermoelectric power plants, gasometers, and new ones such as ( CCPC ), that “capture cooling flue gas purification chimney”, and (VSB), “vertical synergic buildings” with the limestone and photosynthetic greenhouse, which are the subject of other “CTP requests”. But they are also required other inventions, other inventors who do not take off, because the insiders, public and private insist to follow energy production that do not protect the environment, to the maximum can be neutral. Environmental protection and energy production should not be in opposition, but made unique installations that protect the environment by strengthening the natural defense systems. In these works they must contribute the best technology in the field of civil construction, transport techniques and industrial warehouses, production of energy and food in greenhouses, techniques purifying water and air. The new energy system which will be inserted (LDDC), (VSB), (CCPC), with its connections, allows you to intervene at the source of pollution, will also replace the current water purifiers. You will not have to travel miles of trails sewage, pooling many municipalities to purify very little water, without even alkalinizing and not clean the air. The purification will occur on site, with a double drainage system of which a capture the polluted air and smokes and the other waste water and rainwater. While the water is purified in vertical modules purification and sewage sedimentation tanks, $CO_2$ and gas are left thicken and move compressed sections of limestone VSB together with treated water from the same sewer system. The final products of biogas LDDC will be of high quality, containing very little $CO_2$, solid digestive high quality stabilized by a long process of aerobic and dust is calcium oxide, made directly to the drainage bags, and finally, digestive liquid returns to the sections of the photo synthetic VSB to produce biomass that will return in a short time to LDDC. Only in this way can we continue to use fossil fuels, particularly coal, with fewer worries about the health of citizens living near the industries and thermal power plants. Coal can not help but at least to make steel and other industrial products. But also industrial plants that produce steel, cement, waste incinerators, must be designed differently and coupled (CCPC) ,(VSB), (LDCC) and gas tanks.

The amount of water needed for cooling and closing cycles anthropogenic existing plants leave opened must be carefully calculated, before carrying out the installations, because the water does not only serve to cool the turbines and condensers, but also to digest, consume $CO_2$ and carbonates transported to the seas. With global sanitation projects of the brain minder of this work deposited only in Italian, so that they are available to all countries, we can improve the environment while continuing to use fossil fuels. But each plant with fossil fuels should be combined with (LDDC), which recovers waste heat into the environment, while also producing biogas, which will fuel a new power plant located just a few miles away or entered in the urban network closer. Nobody noticed, after two hundred years of industrial history that fossil energy alone can not exist. If the future fossil energy production will be accompanied by the production of biofuels, for technical reasons, not only moral and social, can continue to survive. We can subtract the environment that $CO_2$ that we have entered in two hundred years of industrialization, power plants with scrubbers and wrong. Today, the production of biological fuels still does not take off although already been developed production systems interesting, in particular, in the production of microalgae . If these products have not yet begun on a large scale it is due only to the low cost of fossil fuels and especially to the fact that global rules are not strict enough on the environment on the regulation of the techniques of purifying flue gases, recovery of heat and $CO_2$. Power plants have been built thousands of MWh, not thinking about the possibility of recovering heat and $CO_2$. With the systems proposed by the undersigned, it would be possible for both but would also need at least a tripling of the size and the flow of water passing through the plant, so, only in very few cases the existing thermal power plants, incinerators, steel mills, cement plants can be recovered in full, the environment, without drastic downsizing, due to lack of space and of necessary water.

**The disclosure of this invention**, the subject of this PCT request, multiply the potential digestion and composting of hundreds times than at present, and this is required to power the second industrial revolution , if you do not want to worsen the environmental situation , stealing land for agriculture and intensify artificial fertilization to produce energy. One of the problems posed by the production of biological energy is the large amount of sludge that will be produced. The few existing digesters and sludge product from wastewater treatment plants already put in crisis the current system of processing of the sludge. No digester to the world guarantees 100 % digestion of all organic substances , due to the known phenomenon of short circuit that involves the unavoidable proportion of mixing between materials in and out . To this point, we must add that if we want to recover from environmental heat and CO2 , we necessarily review how to produce and manage the sludge , now be considered still at the craft , as the whole production digestible energy sources , which rarely exceed plants of a single MWh . For this reason , one of the most important sections of the plants are just the global manufactured ( LDDC ), i.e. ” digesters, dehydrators , composters linear ” which are also the boom of the plants from the synergistic processes which today take place separately , without exploiting the benefits that result from this union. The Italian patent pending of “Global synergetic purification plant and energy production (GSPDPTC) begins from the sizing of the tube bundle, which comes out from the recovery of the waste heat of a heating system . From the heat capacity of this shell and tube heat exchanger, building the digester , then the rest of the global economy, which purifies and produces energy . As seen from the drawings, the LDDC is composed of three sections: fig.1 = digestor; fig.2 = composting; fig.3 = dehydration. LDDC is at the center of the system and receives the warm waters of both the plant fossil thermal and biological. Fig.4 shows above the rooms is the treatment of biogas slurry with chambers of bagging compost (bc). Above are the silos containing biomass to digest (bms) and calcium oxide (ls). Below, are the areas of sedimentation, digestion (dg) of biomass, whose storage areas sludge, are separated by ridges, so as to realize the basins that enable autonomous digestions and extractions of sludge, while being only the digester. For each hopper is a hollow dirt collection with an agitator sludge (ags), which acts only in that area. Furthermore, the intervention area is bounded by the walls of separation that descend from above by separating the gas areas and most of those digestive. Of central importance are the hoppers (dlh) serving both for the rapid loading of the biomass, both for the slow process of dehydration and composting of sludge. These, as is seen from fig. 1, for the loading, using the central zone consists of a cylindrical tube equipped with a stirrer paddle vertical (vmix), a shredder with rotating reels (srr) and a final tube discharge with a shutter valve (sh), while the peripheral zone, truncated cone, which serves as accumulation and sludge aeration extracts, is equipped with a simple ramp with perforated tubes (rhp), powered by a electro blowers (efa) that there Atmospheric air enters. Therefore, the timing of anaerobic digestion and the phase of evacuation, dehydration, composting, sludge stabilization and bagging (all that will happen with an aerobic cycle), coincide. This great benefit to the quality of the product and the economics of the process you can get to the digester combining linear and hoppers (dlh) the system of dehydration and chemical stabilization of the sludge already deposited by the undersigned ((Italian patent 0001399595 date of registration 26/04/2013), which allow to have a dehydrated product, bagged compost, in a single process. With this process can be filled slowly and simultaneously hundreds or thousands of sacks. It consists of a large tank (dst) with hundreds or thousands of floating weighing about 350 grams. (float) in which pour the mud held in suspension with dell ‘blown air on the bottom and dilution water. The mud without additives, is extracted from the hopper (dlh) by the pump lifting (psf) and sent to the center of the distribution tank sludge (dst) passing through the filter basket extractable (rbf) and is distributed over the entire surface. This tank, at atmospheric pressure, occupies the entire area of local dehydration, under the tank and floats are suspended draining bags hanging to the logs tube (lt) communicating between them, in which will be fed air blown carrying the powder of calcium oxide metered by the valve (mvc). When the hydrostatic pressure in the tank is strong enough to temporarily lift the floats pass about half a liter of mud to each float that will fall on a conical diffuser (cd) who will distribute it over the entire circumference, prompt separation of the sludge from the water to be released through the porosity of the bag, while the mud, heavier, it will fall into the bag to mix with calcium oxide. Each bag will be mounted on the outside of a cylindrical frame in stainless steel (cf) inside which is mounted a small mechanical stirrer fed with a pneumatic motor (pag), connected to the compressed air outlet with a quick coupling and a manual valve. The power of the air motor will be timed. Fig.3 shows some components of the dewatering system and draining compost in bags. (bc = bagged compost) We can extend the filling of the bags for a time corresponding to almost all the period of digestion, and possibly shorten or lengthen both treatment times according to the characteristics of the energy matrices. In fact, the linear digester, allowing the evacuation of sludge from above, allows to digest, in areas, matrices very different. The supply air, before the hoppers (dlh), then into the distribution tank (dst), and finally in the bags and the moderate rotation of the agitator in the sacks themselves, will have the function and bio-stabilizer aerobically composted of organic substances not digested and mixing calcium oxide powder, in the percentages required by the compost (5-15%), which also ensures the chemical stabilization, contributing to dryness, without compaction. With the emptying of the hopper (dlh) pre-processing, detected with capacitive probes, it will stop the electric pump lifting mud and dilution water (taken from a final biological descent from the pond (sbffv), and thereafter it will close the slide valve the silos of lime (sh), and stop the rotary valve power oxide lime (mvc). This will remain, however, in function blowers which keep the sludge in suspension (efa) and the distribution of compressed air to the agitators, continuing to perform the function of the sludge aeration, for the programmed time. At the end of each DDCL cycle, after replacing the bags (bc), a cycle washing is been carried out of the tank with clean water, coming from (fbcvp), that has been filtered from the bags just fitted, goes to feed the collection basin and oxidation (wbp) of water to be treated. In this basin there is also other wastewater and the supernatant of the digester feeding the biological ponds (bcsvp) and (fbcvp) of VSB building, which are subject of another patent application. With the LDDC system we will be compacted in the rooms of the end treatment hundreds or thousands of bags of compost (bc), mounted on a frame of stainless steel, with an agitator inside a pneumatic control, supported by the same frame. At the end of the cycle, we simply place a small trolley jack under Lunches, disconnect the metal clamps with clamp closure, freeing up the bag from the frame, then move the hand lever of the agitator that facilitates the separation of compost from the frame, lower and remove the bag from the frame with the compost, seal the upper end and through the trolley itself, transport it to the means of transport or hook it to an overhead conveyor which transports the bags in the loading area of the means of transport of the compost. Expecting any accidental breakages of the bags draining the chamber floor filling of the bags will be made with grilled removable fiberglass or steel panels mounted on a common frame filtering: removing the grid and the panel below it recovers completely the dehydrated compost that can be also bagged. The overlap, to the digester, from the street level, this compact system (not bulky) for dehydration and bio-stabilization aerobics and chemical sludge, does not produce bad odors, despite the anaerobic process and sludge treatment. In fact, the air escaping from the drainage bags (bc) is ejected into the atmosphere, but through Dampers gravity and short underground channels will be introduced into the environment of the basin (wbp) and from this, by means of electric fans (efa), in the greenhouse of the basin (wpb) of VSB building, where the air can only escape from the top vents (aout) after suffering through the whole process of deodorization in contact with the limestone (vcmlg). The existing digesters, consisting of bulls, dehydrators, landfills, incinerators, they can not be matched to the greenhouse buildings VSB, which do not exist, they are forced to emit odor, as well as polluting and wasting resources. While not claiming the digestive processes but only the system solutions described above, it is considered appropriate to describe the state of the art anaerobic digestion. There are currently three types of anaerobic digesters: Wet, Dry and Semi-dry, according to the degree of dilution of the refusal to swallow the water. The undersigned has taken into account only the first type, Wet, with the maximum dilution in water, since the global industrial or urban system, in which is inserted in a (DDCL) sewage treatment plant. However, the linear digesters, are very different from other wet digesters. In the wet digesters, due to the physical characteristics of the treated waste, it is not usually possible to obtain a perfectly homogeneous mixture. Accumulations are found at the bottom of the reactor materials with high density and surface crusting due to floating materials. Moreover, it is frequently the short hydraulic circuit which occurs when the flow of the incoming material is mixed with the fluid already present in the reactor and flows out with retention times shorter than those of the project. In the linear digesters these negative phenomena, which are difficult to eliminate in the classical cylindrical digesters, are eliminated by providing a greater amount of loading stations and sludge extraction independent. The mixing between, what goes in and what comes out, not the case, the existing separators in surface area and in the mud, interrupted only in the middle. According to the conception of the subscribed, the digester can be considered as a very long Inhofe tank, from which takes the name as “linear”, equipped with trough-shaped in longitudinal succession, interspersed, the length of about 30 m, not to mix the sludge heavier and surface barriers for not making the rooms adjoining the gas accumulation.

A LDDC can be long kilometers, as the building VSB that assists it. In fact, the common area will be only the middle one, which produces the gas. Transversely the section may be full of baffles delimiting the zones of clarification, sedimentation and digestion to facilitate the intimate contact of the microorganisms, especially, in the digestion zone. Being the LDDC a synergistic system that works in conjunction with other synergistic systems, the overflow of the digesters will skim through the raceways (wodc) and feed the catchment area of the water to be purified (wbp) of the building VSB whose sludge and biomass products fuel the loading hoppers (dhl) of LDDC in the loading phase of the digesters. These hoppers have an important function in the management of the entire system. They will have a truncated inverted trapezoidal shape, with a closing lid insulated double swing, a loading tube provided with a central vertical mixer blades (vmix), a shredder with rotating reels final (srr), an exhaust pipe with a slide valve (sh), three connections for loading the material to digest, which will go from the hoppers (sh), biomass energy from silos (bms) and organic waste from the territory by means specially designed furniture equipped with a system separation, screening, shredding. The hoppers will work, especially, with the reverse flow: will have the function of intermediate reactor in the transfer phase to the dehydration of sludge from the digestion and composting, which will occur with an aerobic system and therefore at this stage will use a ramp (rft) which starts blowing sludge aeration. In fact, assuming the digestive cycle lasting 15 days, we can use the hopper as an aerobic reactor of digested sludge, to be dehydrated and composted for the same period, occurring loading operations through the central tube equipped with stirrer and shredder. The sludge in the hopper are ventilated by a special flight of perforated tubes (rtf) powered by electric fan for air (efa), waiting to go to the dehydration. If we assume to have a linear digester with a total volume of 12.000 m3 of digestion, divided into 10 sections and extract every 15 days, from 8% digesters of the total volume in digestion, having hoppers have 10 of the same volume will be 96 m3 (12.000 * 0.08/10) and round it up to 100 m3.

From the inlet pipe, the organic materials, biomass and sludge, will be released in the sedimentation zone, through the opening of the shutter valve (sh). The lighter particles will attempt the ascent, hampered by baffles (df) and the heavier ones will tend to sink to the bottom, hampered by horizontal flow mixers (ags) (with a scope limited to the valley of the settled sludge) and from the gas tries to rise to the surface. In this way it promotes the mixing and the formation of gas. We mention only the phenomena that occurs in the type of digestion that chosen according to the operating temperature of about 35-37 ° C is defined as mesospheric and taking place in a single-stage digestion chamber. As the digester is different from other digesters, which are fed from above, the identical functions. In fact, the wet digesters, in general, have cylindrical sections, and do not exceed the digestive capacity of 2500 – 3000 m3, while in the example we are considering, we have a capacity of 20.000 m3, with a digestion volume of 12.000 m3, whereas organic matter fills the digesters for about 60% of their capacity, the remaining part is occupied by the gas produced by the biological degradation.

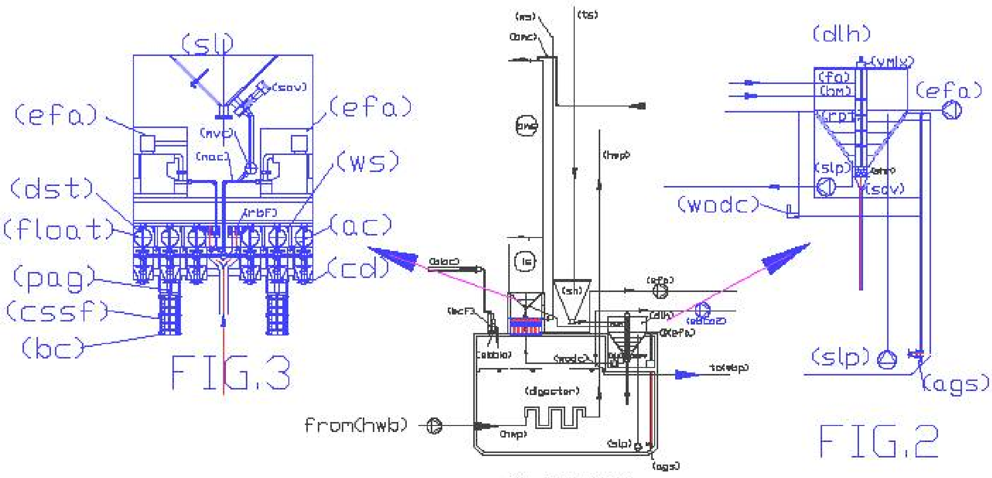
**The production of biogas in LDDC.** The production of biogas from organic waste takes place at the microbial level through an initial biodegradation of the material performed by mold, bacteria and acid genic fermentation; made a subsequent methane in anaerobic environment, only by methanogen bacteria. The phase of biodegradation is divided into two sub-steps: the hydrolysis step, the phase acidic. During the hydrolysis step transformations take place that lead to the degradation of organic substances more complex into simpler compounds, allowing subsequent reactions made by the specific microorganisms: acid fermentation, fermentation alkaline, methanogen phase. At the initial state, however, these substances are made up of polymers, that the bacteria can not assimilate directly. It is then occurred by enzymes the transformation of these macro-molecules into smaller molecules. The bacteria can at this point hydrolyze the primary substrate the solution into simpler molecules. In fact it has the hydrolysis of polysaccharides to simple carbohydrates, proteins to peptides and amino acids, fats to glycerol and fatty acids. In this first phase also, thanks to the micro-organisms of putrefaction kinds Penicillium, Aspergillus, Rhizopus, and the bacteria Bacillus, Pseudomonas, Proteus, Serratia, nitrogen compounds are destroyed. In this stage there is the production of ammonia ($NH_3$), carbon dioxide ($CO_2$) and hydrogen ($H_2$). Acidogenic phase follows in which the products already decomposed are transformed by means of acidogenic bacteria that produce low molecular weight organic acids, alcohols, aldehydes, ketones. In this stage, by the work of Bacterium bacteria, Cellulomonas, Pseudomonas, molds and the cellulose are transformed into glucose. The neutralized acids and there is the formation of salts which, subsequently, are decomposed into carbon dioxide and methane. The methane product results is 72% from the fermentation of acetic acid made by methanogenic bacteria vinegars clastic ($CH_3COOH \rightarrow CH_4 + CO_2$), while the remaining 28% may derive from the reduction of carbon dioxide for about of $H_2$-oxidizing bacteria or by the reduction of methanol possibly product of the first stage. $CO_2 + 4 H_2 \rightarrow CH_4 + 2 H_2O$). You can have limiting conditions within the digester that slow down the speed of reaction, both for the presence of any inhibitory substances, such as residues of pesticides and pharmaceuticals, solvents, disinfectants, residues from treatments of food preservation, heavy metals , salts, ammonia nitrogen ($NH_4^+$) and others. “In a synergistic system, such as that proposed action, these limiting conditions are eliminated by transferring the greenhouse limestone (vcmlg) implant adjacent to the gas side. Being that the biogas is composed of methane and $CO_2$, these gases have a very different weight between them. The $CO_2$ at atmospheric pressure and at a temperature of 35 C° (Ps 1.85 g / l) weighs almost three times as much methane (Ps 0.65 g / l), so if we put the suction valves on the walls of the digester , just above the free surface of the slurry, after measuring the concentration of the gas, with appropriate probes, establishing minimum and maximum thresholds, we can aspire to periodically $CO_2$ with the electric blowers (esbio) and enter it in the greenhouse (vcmlg) adjacent. In this way we aspire also part of the hydrogen sulphide (Ps 1.4 gr / l). The $CO_2$ in the basin (wba) is used as a nutrient to produce other biomass that will produce other biogas, or to produce calcium carbonate, through the corrosion of the limestone. Not pulling it out would be a ballast that reduces the calorific value and performance of the digester. In this way we have of biogas with 80-90% methane, instead of the normal 50-70%. This can not be done in the existing digesters that do not work in synergy with a plant that neutralizes $CO_2$.

Another advantage of this type of reactors, divided in basins, with loading and extraction of the digestive from above, is the possibility to divide the loading zones of the various matrices based on the digestion times of each individual basin. As the energy consumption of zero (recovered from the waste heat of CTE), and being very high volumes available, we can also digest substances with far digestion times, if we do not have anything better to digest.

**Brief description of drawings.** In Disclosure of Invention, the operation of building the (LDDC) has been described and this shows the meaning of the most important acronyms. To better understand how it is good to also bring back the legend of acronyms relating to the systems connected to them.

**Legend:** (ac) air compressor; (af) air filter; (ahu) air handling units; (aid) air inlet dampers; (aout) air outlet; (acwhs) arrival cooling water heating system; (asc) anaerobic sludge collector; (ads) anionic detergent solution; (apt) atmospheric pressure tank; (art) anionic regeneration tunnel, (as) arrival sewer; (avhe) heat ewchanger; (aw) agricultural wastewater; (aws) alkaline water supply; (bcf) biogas cyclone filter; (bc) bagged compost; (bcsvp) biological covered superimposed ponds; (bmh) biomass hopper; (bmpc) biomas pneumatic conveyor; (bmc) biomass collector; (bioc) biogas collector; (brse) basket and racks elefator; (bws) boiler water supply; (casrb) covered area sorting racks and baskets; (CCPC) capture cooling purification chimney; (cd) conical diffuser; (cf) cyclone filter; (clp) condensate lift pump; ($CMCO_2$) collector transport compressed mixture of air and CO2; (crt) cationic regeneration tunnel; (csc) collecting stones channel; (cssf) cylindrical stainless steel frame; (cwhb) calcareous wheeled hanging baskets; (cwlp) cold water lift pump; (cchwf) covered channel for hot water and fumes; (cws) cold water supply; (db) domestic boiler; (dlh) digester loading hopper; (dst) distribution sludge tank; (dst) detergent solution tank; (dwb) downstream water body; (dwt) desalinated water tank; ($ebCO_2$) electroblower for $CO_2$; (ebbio) elettroblower for biogas; (efa) electric fan for air; (eff) electric fan for fumes; (esf) electrostatic filter; (emr) equipped motorized rack; (ethw) expansion tanks for hot water; (etcw) expansion tanks for cold water; (fai) fresh air intake; (fcv) flow control valve; (fvhe) fumes vapor heat exchanger; (fgwe) flue gas water exchanger; (fbcvp) final biological covered vertical pond; (fgfs) flue gas filtration system; (gas) gasometere; (gf) grating floor; (gw) glass wall; (GUED) global urban environmental depuration; (hwb) hot water basin; (hwp) hot water pipes; (hwcb) hot water covered basin; (hwcp) hot water circulating pump; (hwfc) hotwater and fumes channel; (hwlp) hot water lift pump; (hws) hot water supply; (lf) lower floor; (lbh) limestone boulders hopper; (LDDC) linear digester dehydrator composter; (mgg) mini glazing greenhouse; (pbpma) photobioreactors for the production of microalgae; (pag) pneumatic agitator; (pcbio) pneumatic conveying biomass; (plv) rain; (pfb) public facility boiler; (pvlm) purifying vertical lakes module; (pvmm) purifying vertical marines module; (pvum) purifying vertical urbans module; (pwdv) purified water drain valve; (pwo) purified water outlet; (rfwt) resins final washing tunnel; (rc) removable cover; (rcpld) road control panel with mini limestone dosing hopper incorporated; (rpt) ramp with perforated tubes; (rrpwl) recovery rainwater and purified water line; (rsiet) regenerating solution ionic exchange tanks; (rrt) resin regeneration tunnel; (rwt) resins washing tunnel; (rww) resins washing water; (rwhb) resin wheeled hanging baskets; (se) stairwell and elevator; (sfgc) settling flue gas collector; (sh) sludge hopper; (shr) shredder; (sk) skylight; (sid 1-2) smoke interception damper; (sle) sump sludge extraction; (slp) sludge lift pump; (sov); shutoff valve; (spas) submersible pumps for anaerobic sludge; (ssl) settler in sewer line; ($STAMCO_2$) storage tank atmosferic mixture of air and CO2; ($STCMCO_2$) storage tank compressed mixture of air and CO2; (stt) sludge tape transport; (tsp) transparent solar panels; (ttst) transit tank sludge to be thickened; (rwv), recirculating water valve; (TEPbio), thermoelectric power plant fueled by biogas; (TEPfos) thermoelectric power plant fueled with fossil fuels; (tucCO2) thickening CO2 underground collector; (uf) upper floor; (upwb) upstream water body; (uv) unidirectional valve; (vahe) vapor air heat exchanger; (vcmlg) vertical covered mechanized limestone greenhouse; (vmcpg) vertical mechanized covered production greenhouse; (vmix) vertical mixer; (VSB) vertical synergic building; (wb) water body; (wba) water basin to be alkalize; (wbc) water cooling basin; (wbp) water basin to be purified; (wlp) water lifting pump; (wfd) washing floor drain (wodc) water overflow and drainage channel; (wot) water overflow tray; (ws) water supply; (wss) water sofned supply.

**Drawing “1/5”:** figure 1 is the flow LDDC chart. We can see the silos and hoppers for loading the digester (dg) and also the direct outputs for composting, dehydration, that of biogas and connection to the building VSB. Fig 2 shows the magnification of the load section and exit of the material. Figure 3 shows an enlarged section of dehydration, and composting made directly in the drainage bags.

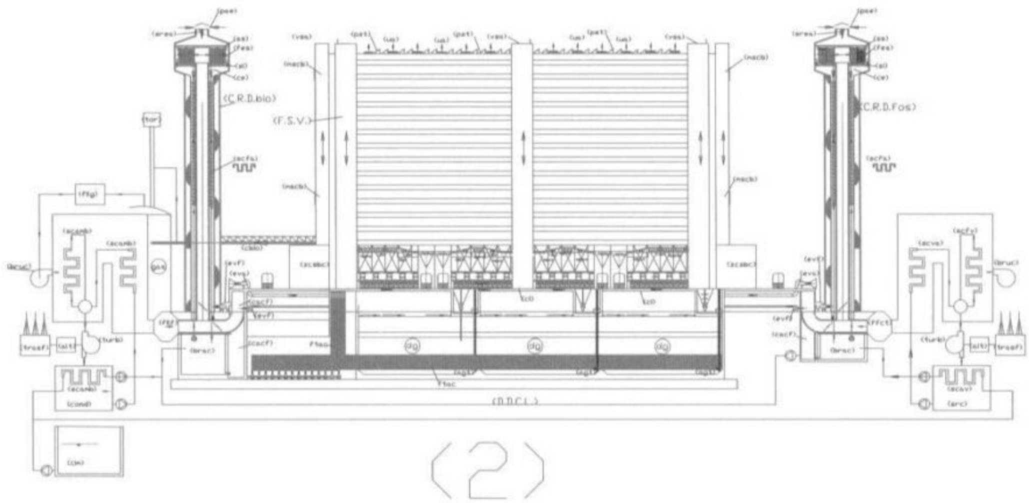



(LDDC)

FIG.1

"1/5"

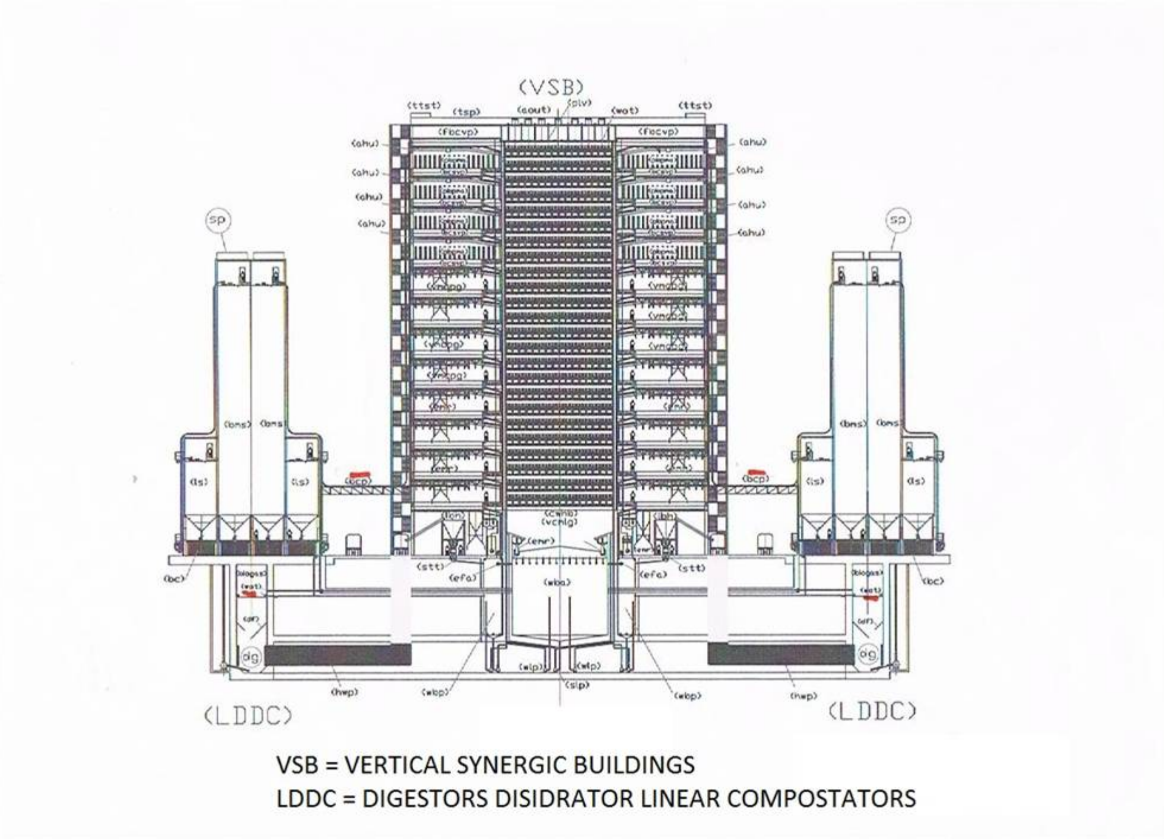
**Drawing "2/5":** fig. 4 is the longitudinal section LDCC, inserted in an industrial plant (GSPDPTC) where you can see the lower area with the bundle tube (hwp) that can be powered either from the thermal upstream plant and downstream from the biological one. Behind the (LDDC) you can see the higher building (VSB). Each (LDDC) must be paired at least with one (VSB) and in a large manufacturing plant energy you may have tens of interspersed lines with VSB and LDDC. The excess biogas produced from this mating goes into gasometers (gas) that feed the urban networks.



(2)

▪

**The following drawing**, is the cross section of the coupling LDCC – VSB in which the first deals with the production of biogas and compost for agriculture, while biomass production, purification of air, water and alkalization of the same with the absorption of CO2 in the same process are entrusted to the VSB building. You can see the silo of biomass (bms) and calcium oxide (ls), the bags with the draining compost (bc), the link between the pans and the basins of infinity of the digesters (wbp), the chamber containing biogas (wba) for the CO2 stripping , and air composting and dehydration always with (wba) which does not broadcast outside odors . All aerobic processes of the building (LDDC) reach the atmosphere passing through (VSB), in particular (vcmlg) and exits into the atmosphere (aout). The water contained in the still hot (hwp) will contribute to warming and drying of the greenhouses (bcsvp), (vcmpg), (pbpma ) and will end in the trays (wot) on top of the greenhouse (vcmpg – cwhb).




**Drawing "5/5":** fig. 7 is the schematic view of GSPDPTC (global synergy plants for depuration, biomass production and thermoelectric cogeneration) in which are inserted VSB together with other industrial installations: 1 ( TEPfos), 2 (CCPCfos), 3 (VSB), 4 (LDDC), 5 (TEPbio), 6 (CCPCfos). Where (TEPfos) produces fossil energy , heat , fumes and $CO_2$; transfers the $CO_2$ and the heat of the fumes to (CCPCfos), while the heat content in the water goes to (LDDC); (CCPCfos) transfers the heat to (LDDC) and $CO_2$ to (VSB). (VSB) produces biomass, which transfers to (LDDC) and alkaline waters that sends to the seas; (LDDC) produces biogas, which transfers to (TEPbio), solid digestate for agriculture and the liquid digestate that moves to ( VSB ), while the hot smoke with $CO_2$ ranging in VSB ; Meanwhile ( TEPbio ) produces biological energy, heat, fumes and $CO_2$; transfers the $CO_2$ and the heat of the fumes to (CCPCbio), while the heat content waters goes to (LDDC). The cycle can continue indefinitely coexist in the same system as fossil fuels and organic which together produce clean energy, compost for agriculture and alkaline waters to combat ocean acidification. Many technologies come into this system, the applying claims only (CCPC), (VSB), (LDDC).

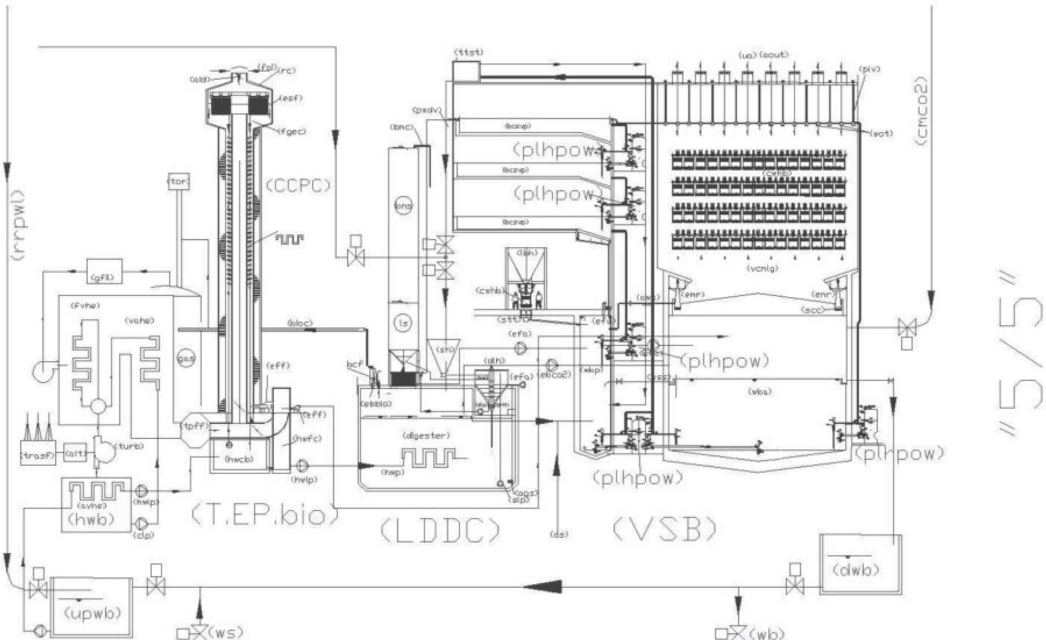
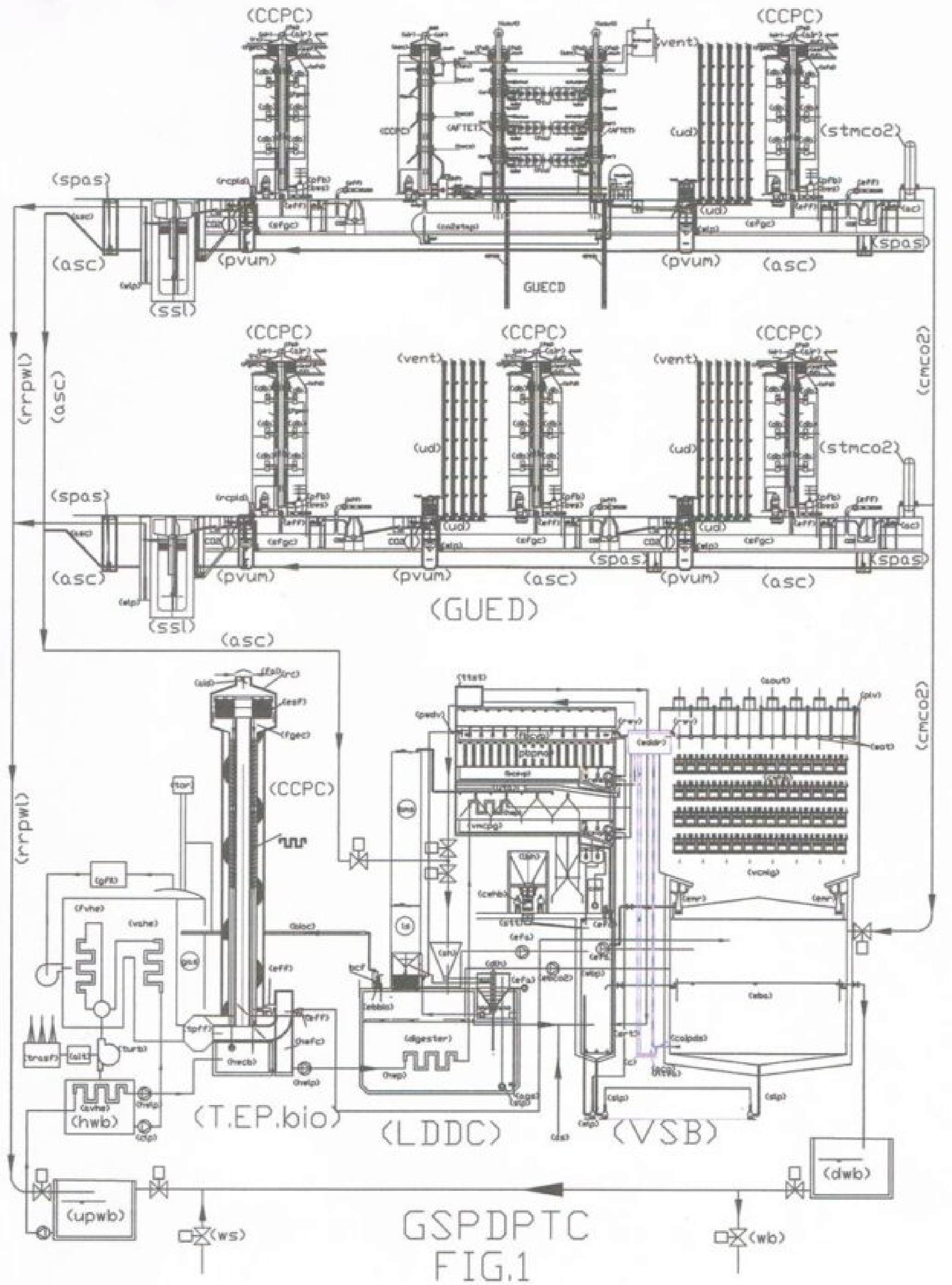


FIG.7

▪

**The following drawing is the schematic view of GSPDPTC (global synergy plants for depuration, biomass production and thermoelectric cogeneration) in which are inserted VSB together with other industrial installations: 1 ( TEPfos), 2 (CCPCfos), 3 (□□VSB), 4 (LDDC), 5 (TEPbio), 6 (CCPCfos). Where (TEPfos) produces fossil energy , heat , fumes and CO2; transfers the CO2 and the heat of the fumes to (CCPCfos), while the heat content in the water goes to (LDDC); (CCPCfos) transfers the heat to (LDDC) and CO2 to (VSB). (VSB) produces biomass, which transfers to (LDDC) and alkaline waters that sends to the seas; (LDDC) produces biogas, which transfers to (TEPbio), solid digestate for agriculture and the liquid digestate that moves to ( VSB ), while the hot smoke with CO2 ranging in VSB ; Meanwhile ( TEPbio ) produces biological energy, heat, fumes and CO2; transfers the CO2 and the heat of**

**the fumes to (CCPCbio), while the heat content waters goes to (LDDC). The cycle can continue indefinitely coexist in the same system as fossil fuels and organic which together produce clean energy, compost for agriculture and alkaline waters to combat ocean acidification. Many technologies come into this system, the applying claims only (CCPC), (VSB), (LDDC).** is the schematic view of GSPDPTC (global synergy plants for depuration, biomass production and thermoelectric cogeneration) in which are inserted VSB together with other industrial installations: 1 ( TEPfos), 2 (CCPCfos), 3 (VSB), 4 (LDDC), 5 (TEPbio), 6 (CCPCfos). Where (TEPfos) produces fossil energy , heat , fumes and $CO_2$; transfers the $CO_2$ and the heat of the fumes to (CCPCfos), while the heat content in the water goes to (LDDC); (CCPCfos) transfers the heat to (LDDC) and $CO_2$ to (VSB). (VSB) produces biomass, which transfers to (LDDC) and alkaline waters that sends to the seas; (LDDC) produces biogas, which transfers to (TEPbio), solid digestate for agriculture and the liquid digestate that moves to ( VSB ), while the hot smoke with $CO_2$ ranging in VSB ; Meanwhile ( TEPbio ) produces biological energy, heat, fumes and $CO_2$; transfers the $CO_2$ and the heat of the fumes to (CCPCbio), while the heat content waters goes to (LDDC). The cycle can continue indefinitely coexist in the same system as fossil fuels and organic which together produce clean energy, compost for agriculture and alkaline waters to combat ocean acidification. Many technologies come into this system, the applying claims only (CCPC), (VSB), (LDDC).




GSPDPTC
FIG.1
LEGEND

GSPDPTC (GLOBAL SYNERGY PLANT FOR WATER AND AIR DEPURATION BIOMAS PRODUCTION, THERMO ELECTRIC COGENERATION)
acg (alternating current generator); aout (air outlet); asc (anaerobic sludge collector); bcsvp (biological covered superimposed ponds); bms (biomass silo); c (collector); calpds (capsid axial intubate pump with dual suction pump); CCPC (capture cooling purifier chimney); cmco2 (collector transport compressed mixture of air and co2); dlh (digester loading hopper;); dwb (downstream water body). fbcvp (final biological covered vertical pond); gas (gasometer); ebco2 (electroblowerfor CO2); ebbio (electroblowerfor biogas); efa (electric fan for air); emr (equipped motorized rack); esf (electrostatic filter); GUED (global urban environmental depuration); htva (hydraulic turbine with vertical axis); hwp (hot water pipes); LDDC (linear digester dehydrator composter); ls (line silo); mgg (mini gazing greenhouse; pbpma (photobioreactors for the production of microalgae); plv (pluvial for water rain); pvum (purifiervertical urban module); pwdv (purified water drain valve); rwv (recycle water valve; rrpwl (recovery raiwater and purified water line); slp (sludge lift pump), spas (submergible pump for anaerobic sludge); srt (supply reservoir tube); ssl (settler in sewer line); vmcpg (vertical mechanized covered production greenhouse); VSB (vertical synergic building; ttst (transit tank of sludge to be thickened); TEPbio (thermoelectric plant fueled with biogas; vcmlg (vertical covered mechanized limestone greenhouse); upwb (upstream water body); wba (water basin to be alkalize; wbp (water basin to be purified); wddr (water distribution and disconnection reservoir); wlp (water lift pump); wot (water overflow tray).

▪

**Industrial applicability.** The drawings and explanations you see show how important and strategic the (LDDC) in industrial and urban areas, to produce biological energy, minerals return to the earth and the seas carbonates, especially if combined with air pollution capture systems (new chimneys and new sewer systems and buildings (VSB) it is much easier to capture on earth pollution and recover the energy contained in the heat through (LDDC) than trying to heat the urban centers in places many miles away, where the costs of the insulations and the capillary distribution make it not convenient to recover the same. Moreover, the heating of the city is not required for the whole year. Considering that both pollution recovered heat will be used to produce new energy, even from the economic point of view these systems are interesting, not to mention the social aspect, that of the job opportunities that should interest the governments, if not entrepreneurs. it can be said that if up to now we have not reached the industrialization of the protection of environment, it is precisely because there are missing works such as (CCPC), (VSB), (LDDC) connected to each other in which we combine the best technologies of civil construction, industrial, agricultural, biological and applied chemistry. This is deeply flawed with the current energy policy, which is considered as a state of the art, because it only produces biological energy instead of fossil fuels, but would not recover the heat and not alkaline the waters that go down to the sea and not being able to transfer the $CO_2$ content in the biogas to produce biogas VSB low-energy capacity. the new productions biological energy that are being developed around the world, are taking a step forward compared to the current thermal power plants, but they are already obsolete compared to innovations (CCPC), (VSB) and (LDDC) that lead to energy production not simply clean but also competitive and protective of the environment because they do not miss anything, in particular the heat and $CO_2$. subtraction of $CO_2$, albeit organic, made through the coupling with the VSB, goes to compensate those subtractions of $CO_2$ that are beyond the control of man, for technical reasons or natural (forest fires, volcanic eruptions, etc.)

**Principal Claim**

Multifunctional plant for digestion, dehydration and composting, characterised by the fact that it [j1] consists of a long, continuous linear wet digestion tank inground[j2] , separated into approximately 35 meter long compartments that allow for optimal concurrent processing of different types of biomass[j3] ; each compartment is separated from its neighbour by bumps[j4]  in the lower zone and the walls in the upper zone; the intermediate zone in the height of the bath digestive (dg) is open and [j5] in common to all the sections

to equalize the mesophilic temperature (about 37 °C; the loading and unloading of the material is from above by means of hoppers; the heating takes place by means of hot water pipes (hwp) that contains the water used to cool the power plant turbines and condensers; the digestion is shaken by agitator sludge (ags) that can be lifted from the top[j6] ; sludge[j7]  is lifted by a submersible pump (slp) in the peripheral zone of the hopper (dlh); the aerated digestate is raised by other sludge lift pump, to section of dehydration, and composting where the processes made □□directly in bagged [j8] compost (bc); the biogas produced, is filtered by biogas cyclone filter (bcf) and sent by electric blower (ebbio) to[j9]  gasometer (gas) by biogas collector (bioc); the sewage overflow, and the liquid digestate released by drainage bags (bc), by overflow trays (wot), is sent [j10] to water basin to be purified (wbp) located in the [j11] vertical synergic building (VSB)

luigi Antonio Pezone