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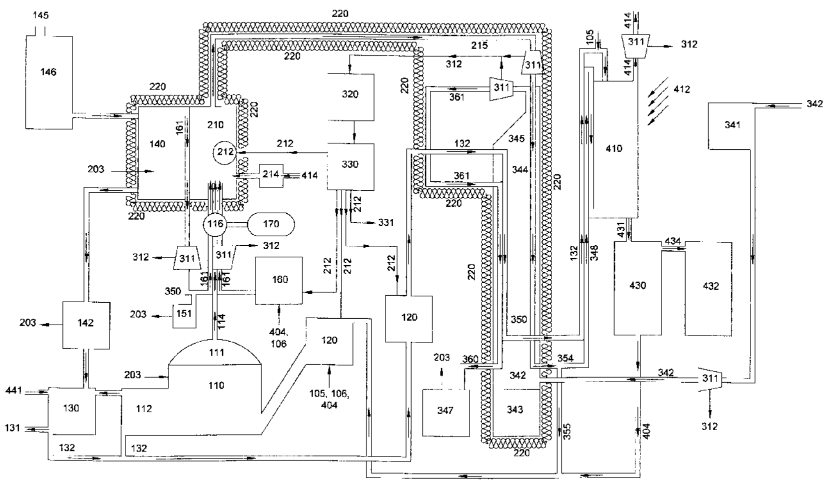

Figure 6

(57) Abstract: It is described an integrated system for organic matter recycling that reproduces the natural carbon cycle and provides the production of benefits and/or by-products at each stage of the system, said system comprehends an organic matter decomposition unit (100) with an anaerobic digester (110) with a culture of acidogenic and acetogenic bacteria and methanogenic microorganisms to produce biogas (114) and digestate (115), a combustion unit (200) that presents a combustion chamber (210), a cooling unit (300) that comprehends a heat engine (310) with heat source (203) comprised by heated exhaust gas (215) received from the combustion unit (200 and cold sink comprised by refrigerant substance (304), and a synthesis unit (400) that comprehends a photobioreactor (410) or any other natural photosynthesis environment to produce oxygen (414), biomass (404) and hydrocarbons (434).

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INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING

FIELD OF THE INVENTION

The present invention relates to an integrated system for organic matter recycling. More particularly, it discloses a system that reproduces the natural carbon cycle and provides the production of benefits and/or by-products at each stage of the system, with the recycling of the by-products generated in the previous stages of the system.

PRIOR ART

Organic matter is defined biologically as matter with animal or vegetable origin, and geologically as composts of organic origin found above the surface of the soil.

Recycling is the term generally used to designate the re-use of materials as raw materials for new products.

The management of wastes, especially their organic component, is becoming a question each time more concern due to the conventional treatment (disposal to landfills) , that do not utilise the organic matter and discharge methane to the atmosphere (a gas that contributes to the greenhouse effect) and the lack of use of its potential to be transformed into by-products of economic interest.

Currently, organic matter is being utilised in the generation of biogas, a type of gaseous mixture of carbon dioxide (CO_2) an methane (CH_4), produced naturally in anaerobic environment by the action of microorganisms in organic matter, that is fermented in between determined limits of temperature, humidity and acidity.

However, biogas generating plants, like traditional thermal power stations, emit large quantities of CO_2 to the atmosphere, bringing up questions about global warming.

During the period of at least 10,000 years before the industrial revolution, the concentration of CO_2 in the atmosphere was maintained constant between 260 and 280 particles per million (ppm). However, since 1850, due to the industrialization, the concentration of CO_2 in the atmosphere began to increase progressively, and since 2003, the concentration of CO_2 has been increasing at a rate above 2 ppm per year, achieving a total of 390 ppm in 2010.

Many technical solutions aim to solve this problem, completing the carbon cycle through the utilisation of bio-reactors, containing algae that recycle the CO_2, transforming it in biomass or hydrocarbons (generally combustible), through the process of photosynthesis.

However, these solutions are limited by having as objective only reducing the emission of pollutants in the production of energy, ignoring the immense recycling potential and other benefits offered by the carbon cycle.

Other technical solutions emphasize the recycling and accomplish carbon sequestration or treatment of organic wastes; however, they do not use the carbon cycle.

Prior art describes some of these solutions, such as the document US2009/003828, that provides for the production of fuels from algae using the carbon cycle, including bio-reactor, anaerobic digester and a catalyst to convert syngas into liquid fuels, being the carbon dioxide produced by the anaerobic digester transferred directly to the bio-reactor, closing the cycle.

The document DE102007007131 describes a biogas power plant coupled to a bio-reactor containing algae.

The documents US6477841B1 and GB2254858 describe the use of recycled residue of the combustion of fuel to the raise algae.

The document US2008/0166265 describes a plant that generates syngas from sewer and other wastes using a plasma converter. The gas is oxidised to generate energy and the wastes are recycled in the bio-reactor and processed by the plasma converted, closing the cycle.

The document US2008/0166790 describes the production of energy and fuels using the carbon cycle through a bio-reactor, a plasma converter and heat engine.

The document US2010/000699 describes processes of sequestering carbon emitted in several processes, using a bio-reactor and anaerobic digester, in a non-cyclical process.

The document US2008/0050800 describes a non-cyclic process of energy production from agricultural wastes as raw material.

However, prior art do not describes nor suggest a system that reproduces the natural carbon cycle and provides the production of benefits pr by-products at each stage of the system, adapted to many applications, with the recycling of by-products from precious stages of the system, this integrated system for organic matter recycling is described and claimed in the present application.

SUMMARY

The invention describes an integrated system for organic matter recycling that uses 4 processes in a system that reproduces the carbon's natural cycle – decomposition, combustion, cooling and synthesis.

The invention provides an integrated system for organic matter recycling with potential use in the treatment of organic wastes, power generation, carbon sequestration, production of biofuels, fertilizers, oxygen and biomass, soil improvement, heating, water desalination and sewage treatment.

The invention provides an integrated system for organic matter recycling that promotes flexibility, efficiency and self-sufficiency, because the residues of each stage can be used as raw materials in other stages or be used as by-products.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 presents a simplified schematic diagram of the integrated system for organic matter recycling, making evident the inter-relationship between the organic matter decomposition unit (100), the combustion unit (200), the cooling unit (300), and the synthesis unit (400).

Figure 2 presents schematic representations of possible configurations for the organic matter decomposition unit (100), where the figure 2A presents a simple configuration, including only the anaerobic digester (110) and reservoirs for biogas (111) and digestate (112); figure 2B presents a simple configuration, including only the pyrolisis chamber (140); figure 2C presents a configuration that combines anaerobic digester (110), a composting chamber (130) and a pyrolisis chamber (140); figure 2D presents a pyrolisis chamber (140) including bio-oil (152) condensing system (350); figure 2E presents the plasma converter (160).

Figure 3 presents schematic representation of possible configurations for the combustion unit (200), being figure 3A the simplest possible configuration, including only the combustion chamber (210); figure 3B presents a combustion chamber (210) integrated to a pyrolisis chamber (140), where both chambers are involved in thermal insulation (220); figure 3C is similar to 3B but including a turbine to use the energy (312) from the pressure of the syngas (161) generated in the pyrolisis chamber (140); figure 3D is a variation of figure 3C, adding a condenser (350) to separate bio-oil (152) and an equipment (146) to grind and store the biomass from cellulosic origin (145) before that it is directed to the pyrolisis chamber (140); and figure 3E presents a internal combustion engine (230) type Otto, Atkinson, or similar, coupled to a electric generator (320) and a battery (330).

Figure 4 presents schematic representations of possible configurations for the cooling unit (300), being figure 4A the simplest possible configuration, including only the heat engine (310), representing a Stirling engine or thermoelectric generator, among others; figure 4B presents a heat engine (310) similar to Rankine cycle, where a refrigerant travels through a closed cycled, being vaporized (361) and condensed (360) at each cycle; figure 4C is similar to the previous figure, with the addition of an electric generator (320) and a battery (330); figure 4D is a variation of figure 4B where the refrigerant is comprised by saline water (342), where in this case the refrigerant is constantly replenished in order to desalinate the largest possible quantity of saline water (342); and figure 4E is a variation of figure 4D, where are present a electric generator (320) and a battery (330).

Figure 5 presents schematic representations of possible configurations for the synthesis unit (400), being figure 5A the simplest possible configuration for the synthesis unit (400), including only the photobioreactor (410); figure 5B presents a system that includes the photobioreactor (410), turbine (311) to use the energy of the pressure of the oxygen (O_2) (414) and other gases produced, and system for separating and processing hydrocarbons (430), and figure 5C presents a system where the photosynthesis medium is comprised by a greenhouse (440).

Figure 6 presents a schematic diagram of the integrated system for organic matter recycling, evidencing the most complete and preferred form of the invention, with double lines representing material transport ducts between different components.

DETAILED DESCRIPTION OF THE INVENTION

The integrated organic matter recycling system that reproduces the natural carbon cycle and provides the production of benefits and/or by-products at each stage of the system, object of the present invention, comprehends a organic matter decomposition unit (100), a combustion unit (200), a cooling unit (300) and a synthesis unit (400).

The decomposition unit (100) comprehends an anaerobic digester (110) with a culture of acidogenic and acetogenic bacteria and methanogenic microorganisms.

Organic residue (106) are deposited into the anaerobic digester (110), said residue (106) are selected among algae deriving from the synthesis unit (400), biomass (404), manure or organic wastes.

The microorganisms present in the digester (110) digest the organic residue, producing biogas (114) and digestate (115). The digestate can be used as fertilizer (132).

The anaerobic digester (110) has a reservoir (111) in the superior portion to store biogas (114) and a second reservoir (112) at opposite to the feeding point to store digestate (115)

Preferably, the contents of the anaerobic digester (110) must contain termophile microorganisms and be maintained at a temperature between 50°C and 52°C, with heat source (203) received from the combustion unit (200).

Preferably, the organic matter (106) is disposed into the digester (110) through a grinder pump (120).

Optionally, part of the digestate (115) if supplied to a composting chamber (130) containing worms of the species *Eisenia foetida, Eisenia Andrei, Eisenia hortensis, Enchytraeus buchholzi* or *Pontoscolex corethrurus*, among others.

The composting chamber (130) can also receive biomass (404) to the production of humus (130) and liquid fertilizer (132).

Optionally, a pyrolisis chamber (140) containing biomass (404), preferably biomass of cellulosic origin (145), is heated to a temperature between 450°C to 550°C, generating biochar (143) and syngas (161).

Preferably, the heat source (203) is received from the combustion unit (200).

Preferably, the biomass from cellulosic origin (145) passes through a grinding and storage device (146) before being sent to the pyrolisis chamber (140).

Preferably, the biochar (143) is cooled with refrigerant (304) received from the cooling unit (300) and pulverized in a pulveriser (142). The pulverized biochar (144) is supplied to the composting chamber (130), in order to produce *terra preta*, a compost with excellent fertilizing qualities and great capacity to recover infertile soils.

The syngas (161) generated by the pyrolisis chamber (140) is collected and directed to the combustion chamber (210) in order to contribute with the burning process.

Preferably, a condenser (350) is placed in between the pyrolisis chamber (140) gas exhaust and the combustion chamber (210) in order to condense bio-oil (152), stored in a recipient (151). Preferably, the condenser (350) is cooled by refrigerant (304) of the cooling unit (300). Preferably, the condenser (350) must maintain a minimum temperature above 100°C in order to avoid condensing water.

Optionally, the anaerobic digester (110) can be replaced or work in parallel with a chamber containing organic wastes (106) and a plasma converter (160) that will convert organic matter (106) into syngas (161) and a small proportion (approximately 20% in weight, or 5% in volume) of inorganic by-products, known as slag (162), that has many applications, such as construction material (bricks, gravel, sand, concrete additive, thermal insulation), depending on the way it is processed.

Preferably, turbines (311) are placed in the gas exhaust of each of the different decomposition systems (110, 140, 160) in order to capture the gas' pressure energy.

The gases (114, 161) generated in the decomposition unit (100) are used to feed the combustion unit (200).

The combustion unit (200) has a combustion chamber (210) with heat source (203) feed by fuel (231) and oxygen (414).

Preferably, the fuel (231) us comprised by the gases (114, 161) generated in the decomposition unit (100).

Preferably, the combustion unit (200) includes a valve (116) in the gas inlet that regulates the quantities of gas coming from the different decomposition systems (110, 140, 160) that will be directed to the combustion unit (210 and the excess that will be directed to a reservoir or external gas distribution system.

Preferably, the combustion chamber (210) includes an ignition system (212) fed by the electricity (321) generated in the cooling unit (300).

The combustion chamber (210) produces heated exhaust gases (215) comprised by nitrogen, water vapour and carbon dioxide.

Preferably, the combustion unit (200) and other points of the system that receive heat (203) of the combustion unit (200) are separated from the external environment by thermally insulating material (220) in order to avoid unnecessary heat losses.

Preferably, check valve (214) or a compressor is placed in the oxygen inlet (414) in order to avoid the gas leaks.

The cooling unit (300) comprehends a heat engine (310) like Stirling engines, steam engines, thermoelectric generators, among others, with heat source (203) comprised by the heated exhaust gas (215) received from the combustion unit (200) and cold sink comprised by refrigerant (304).

If a steam engine of the Rankine type is used as heat engine (310), a boiler or evaporator (344) transfers the thermal energy stored in the exhaust gas (215) to the refrigerant (304), heated said refrigerant (304) progressively to a temperature above its boiling point (345) , at the same time that the exhaust gas is progressively cooled

(348). The refrigerant (304), that initially was in liquid phase (360), becomes gas (361), that passes through a turbine (311), generating mechanic energy (312). The refrigerant in gaseous phase (361) then passes through a condenser (350), having its temperature reduced and consequently reverting to the liquid phase (360).

Preferably, the refrigerant substance (304) is comprised by cold saline water (342). Before entering into the system, the cold saline water (342) must be free of solids and impurities, being stored in a specific tank (341). In the heat engine (310), the water is heated (351), distilled (349) and stored in a specific reservoir (347), and the salt (353) is stored in another specific reservoir (343).

If a thermoelectric generator is used as heat engine (310), the temperature difference between the heat source (203) and the cold sink (304) will be converted directly in electricity (321). In other cases, said temperature difference will be converted by the heat engine (310) in mechanic energy (312). An electric generator (320) converts the said mechanic energy (312) in electricity (321).

The electricity (321) generated in the system is stored in a battery (330). The battery (330) can be connected to the public electric energy supply (331) both to provide energy (when the system is producing excess energy) and to receive energy (when the system needs external energy).

After passing through the heat engine (310), the temperature of the cooled exhaust gas (348) is close to the external environment's temperature.

Preferably, a collecting device (354) recover the condensed liquids (355), preventing these liquids from impairing the proper functioning of the system.

Optionally, the combustion unit (200) and the cooling unit (300) can be replaced by an internal combustion engine (230) using the cycles Otto, Atkinson or similar, coupled to an electric generator (320) and a radiator or equivalent for the cooling operation.

The synthesis unit (400) comprehends a photobioreactor (410) or any other natural photosynthesis environment, exposed to a light source (412), preferably sunlight, and fed with carbon dioxide, water, fertilizers (132) and nutrients (105) as needed, to produce biomass (404) and emit of oxygen (414).

Optionally, artificial lighting can be supplied for continuing functioning during night time.

Preferably, in the oxygen exhaust (414) is placed a turbine (311) that converts the difference in the gas pressure between the external and internal environment in mechanical energy (312).

It is preferred that the water, fertilizer (132) and nutrients (105) be sterilized before being added to the photobioreactor (410).

It is preferred that the fertilizer (132) be pumped to the photobioreactor (410) by a grinder pump (120).

The carbon dioxide added to the photobioreactor (410) is part of the exhaust gas (348) produced by the combustion chamber (210), and cooled by the heat engine (310).

The photobioreactor (410) has photosynthetic organisms (431), such as macro algae, microalgae, cyanobacteria, among others. The organisms (431) produced in the photobioreactor (410) are collected and separated from the aqueous environment. It is preferred that the hydrocarbons (434) present in the composition of the organisms (431) are separated, refined and transesterified in processing equipment (430) and later stored in reservoirs (432). The remaining biomass (404) can be recycled in the anaerobic digester (110).

Optionally, the photobioreactor (410) can work in parallel or be replaced by a greenhouse (440) for the production of hydrocarbons (434) and biomass (404) through the cultivation of plants.

In the form described in this document, the system generates products such as humus (131), fertilizer, biochar (143), biogas (114), syngas (161), mechanical energy (312), electricity (321), heating (203), salt (353), desalinated water (349), oxygen (414), biomass (404) and hydrocarbons (434).

Most of the by-products generated during the process can be reused in the system, such as organic residue (106), electricity (321), fuels (231), nutrients (105), water and oxygen (414).

CLAIMS:

1. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING characterised for comprehending:
   a) An organic matter decomposition unit (100) that comprehends an anaerobic digester (110) with a culture of acidogenic and acetogenic bacteria and methanogenic microorganisms for the production of biogas (114) and digestate (115), said anaerobic digester (110) includes a reservoir (111) in the upper portion for the storage of biogas (114) and a second reservoir opposite to the feeding point to store digestate (115);
   b) A combustion unit (200) that presents a combustion chamber (210) with heat source (203) fed by fuel (231) and oxygen (414);
   c) A cooling unit (300) that comprehends a heat engine (310) with heat source (203) comprised by heated exhaust gas (215) received from the combustion unit (200) and cold sink comprised by refrigerant substance (304);
   d) A synthesis unit (400) that comprehends a photobioreactor (410) or any other natural photosynthesis environment, exposed to a light source (412) and fed with carbon dioxide, water, fertilizers (132) and nutrients (105) as needed, to produce biomass (404) and releasing oxygen (414).
2. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that the organic residue (106) deposited into the anaerobic digester (110) being preferably selected among algae provided by the synthesis unit (400), biomass (404), manure or organic waste.

3. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that preferably, the anaerobic digester (110) contains termophile microorganisms and be maintained at a temperature between 50°C e 52°C, with heat source (203) received from the combustion unit (200).

4. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that the organic matter (106) is deposited in the digester (110) through a grinder pump (120).

5. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that optionally, part of the digestate (115) is supplied to a composting chamber (130) containing worms of the species *Eisenia foetida, Eisenia Andrei, Eisenia hortensis, Enchytraeus buchholzi* ou *Pontoscolex corethrurus*, among others.

6. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 5, characterized by the fact that the composting chamber (130) receive biomass (404) to produce humus (131) and liquid fertilizer (132).

7. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 5, characterized by the fact that the composting chamber (130) receive pulverized biochar to produce *terra preta*.

8. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that the organic matter decomposition unit (100) optionally presents a pyrolisis chamber (140) containing biomass (404) heated to a temperature

between 450°C to 550°C to produce biochar (143) and syngas (161) directed to the combustion chamber (210).

9. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 8, characterized by the fact that preferably a condenser (350) is located between the pyrolisis chamber's (140) gas exhaust and the combustion chamber (210) to condense bio-oil (152) that is stored in a reservoir (151).

10. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 8, characterized by the fact that preferably biomass from cellulosic origin (145) is used.

11. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 8, characterized by the fact that the cellulosic biomass passes through a equipment for grinding and storage (146) before being supplied to the pyrolisis chamber (140).

12. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that the anaerobic digester (110) optionally be replaced or work in parallel with a chamber containing organic wastes (106) and a plasma converter (160) to convert the organic matter (106) in syngas (161) and slag (162).

13. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that preferably the fuel (231) of the combustion chamber (210) be comprised by gases (114, 161) produced in the decomposition unit (100).

14. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that the heat engine (310) is a steam engine of Rankine type with a boiler or

evaporator (344) that transfers the heat energy stored in the exhaust gas (215) to the refrigerant substance (304), heating said refrigerant substance (304) progressively up to a temperature above its boiling point (345), at the same time that the exhaust gas is progressively cooled (348), with the refrigerant substance (304) that was initially in liquid phase (360) becoming gas (361), that passes through a turbine (311), generating mechanical energy (312), and the refrigerant substance in gas phase (361) passing through a condenser (350), having its temperature reduced and returning to the liquid phase (360), presenting a electric generator (320) that converts said mechanic energy (312) in electricity (321).

15. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that preferably, the refrigerant substance (304) is comprised by cool saline water (342) previously stored in specific tank (341), and in the heat engine (310) said saline water is heated (351), distilled (349) and stored in specific reservoir (347), being the salt (353) stored in another specific reservoir (343).

16. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that the heat engine (310) is a thermoelectric generator where the temperature difference between the heat source (203) and the cold sink (304) is converted directly in electricity (321) stored in a battery (330).

17. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that optionally, the combustion unit (200) and the cooling unit (300) are replaced by a

system comprised by internal combustion engine (230) using Otto, Atkinson or similar cycle, coupled to a electric generator (320), with a radiator or equivalent for the cooling function.

18. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that the photobioreactor (410) photosynthetic organisms (431), with the hydrocarbons (434) present in the composition of said organisms being separated, refined and transesterified in processing equipment (430) and later stored in reservoirs (432) and the remaining biomass (404) being recycled in the anaerobic digester (110).

19. INTEGRATED SYSTEM FOR ORGANIC MATTER RECYCLING, according to claim 1, characterized by the fact that optionally, the photobioreactor (410) works in parallel or be replaced by a greenhouse (440) to produce hydrocarbons (434) and biomass through the cultivation of plants.

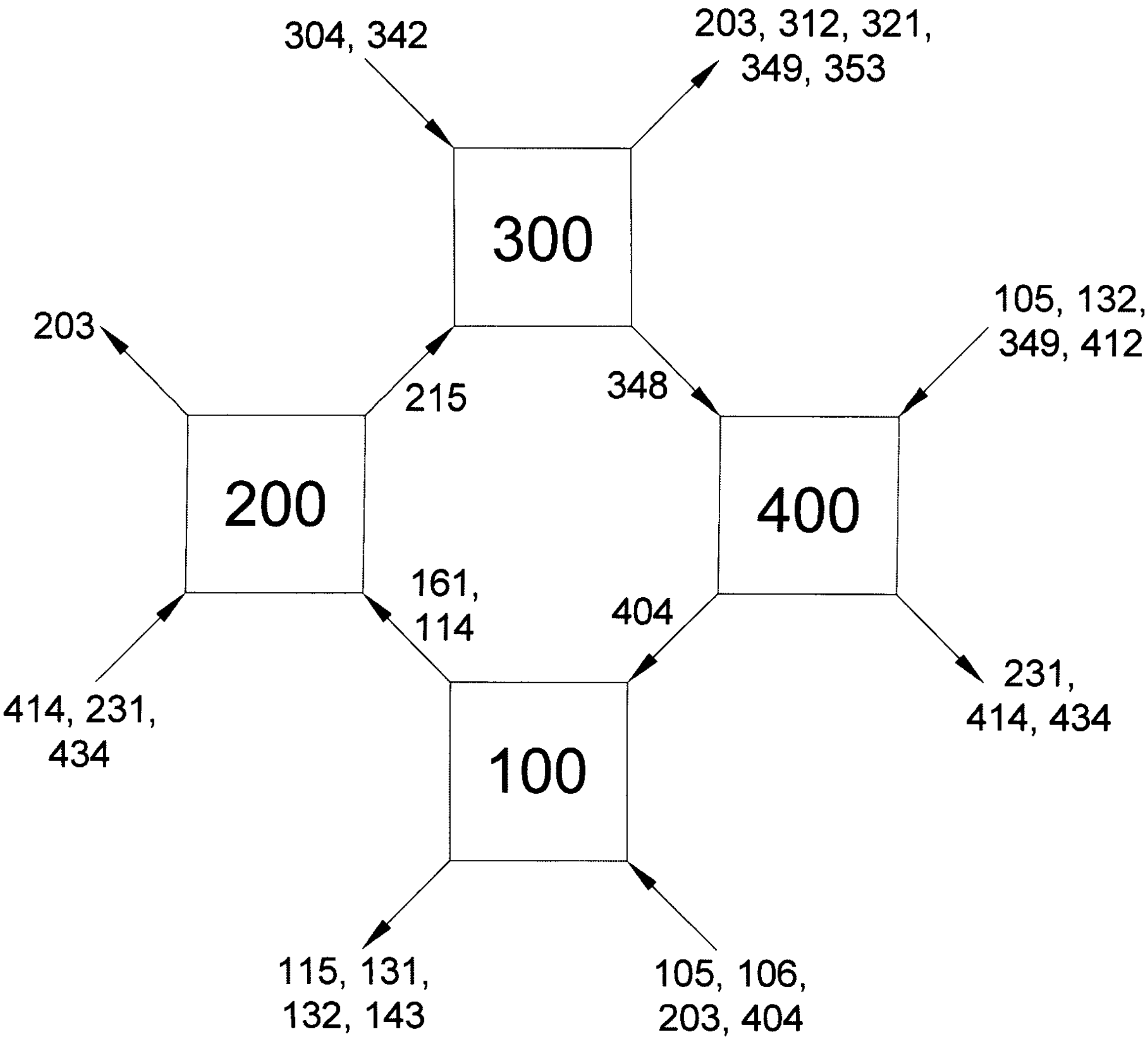
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Figure 1

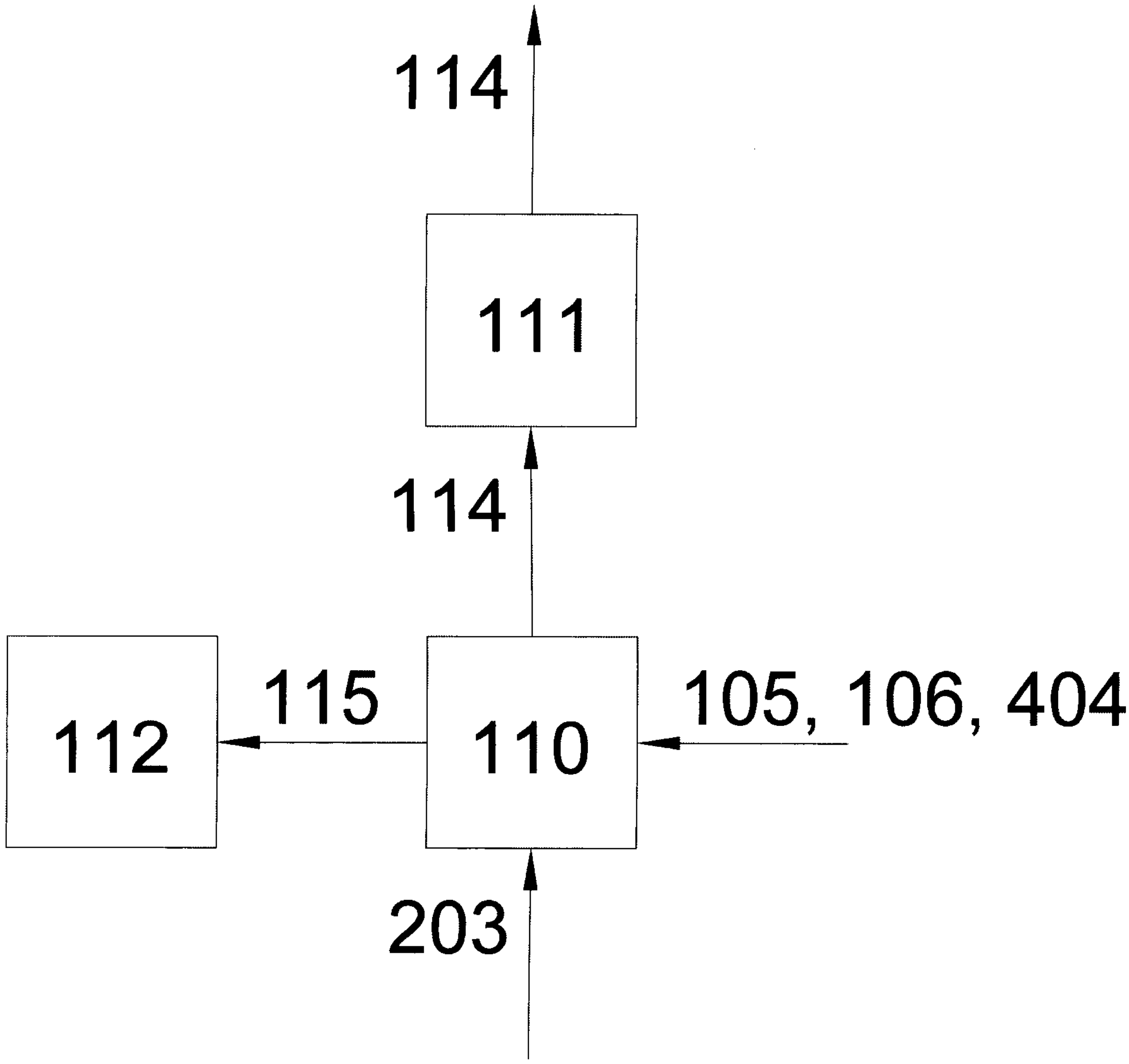
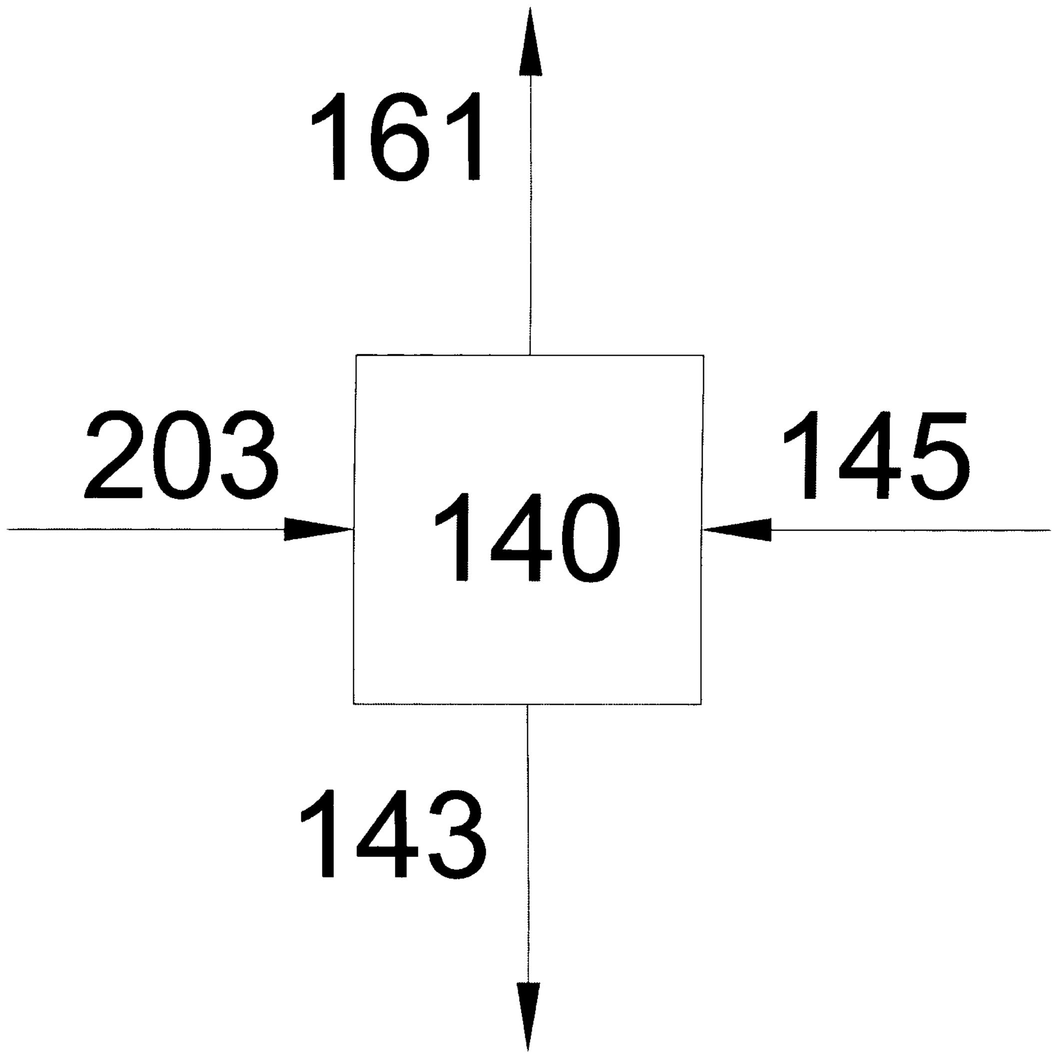


Figure 2A



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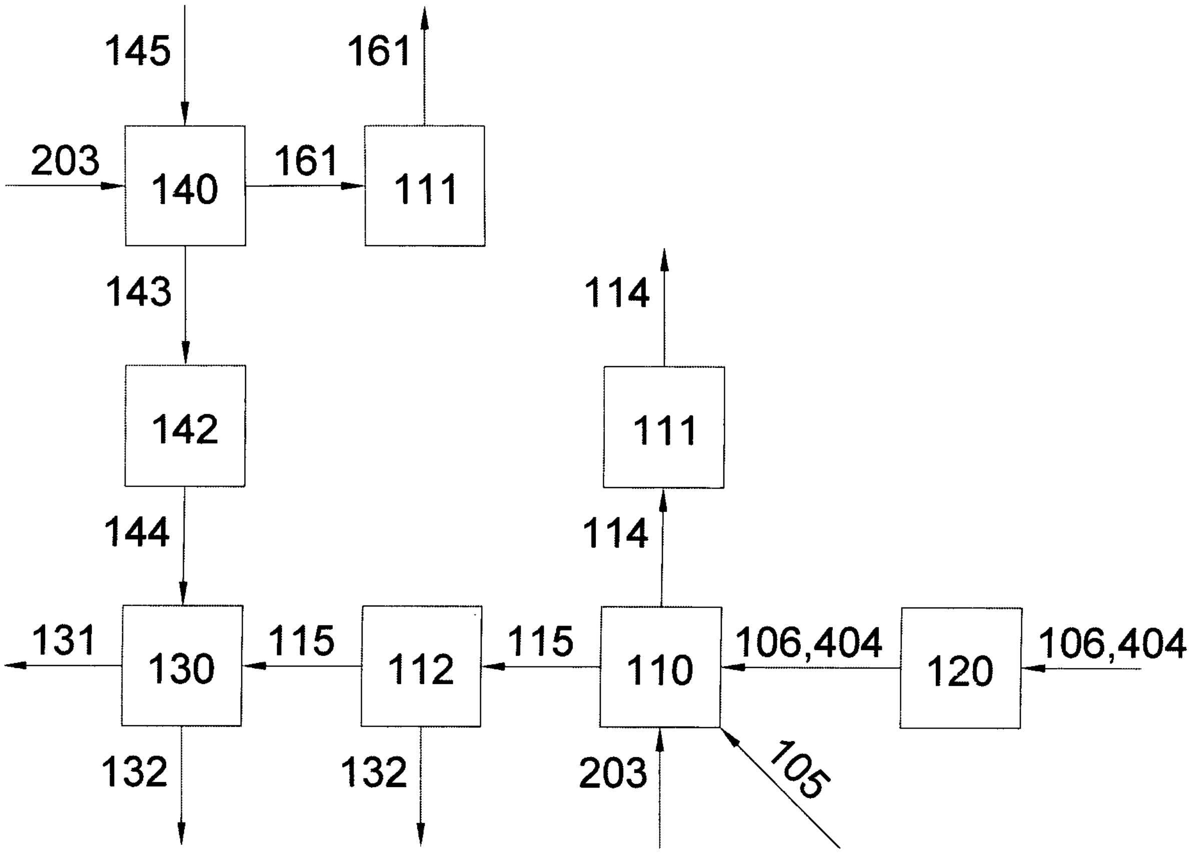
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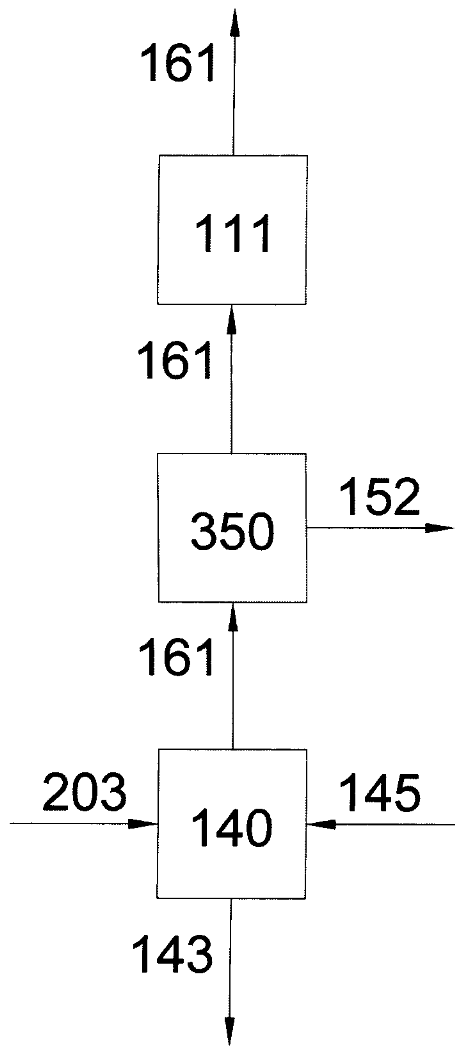
Figure 2C



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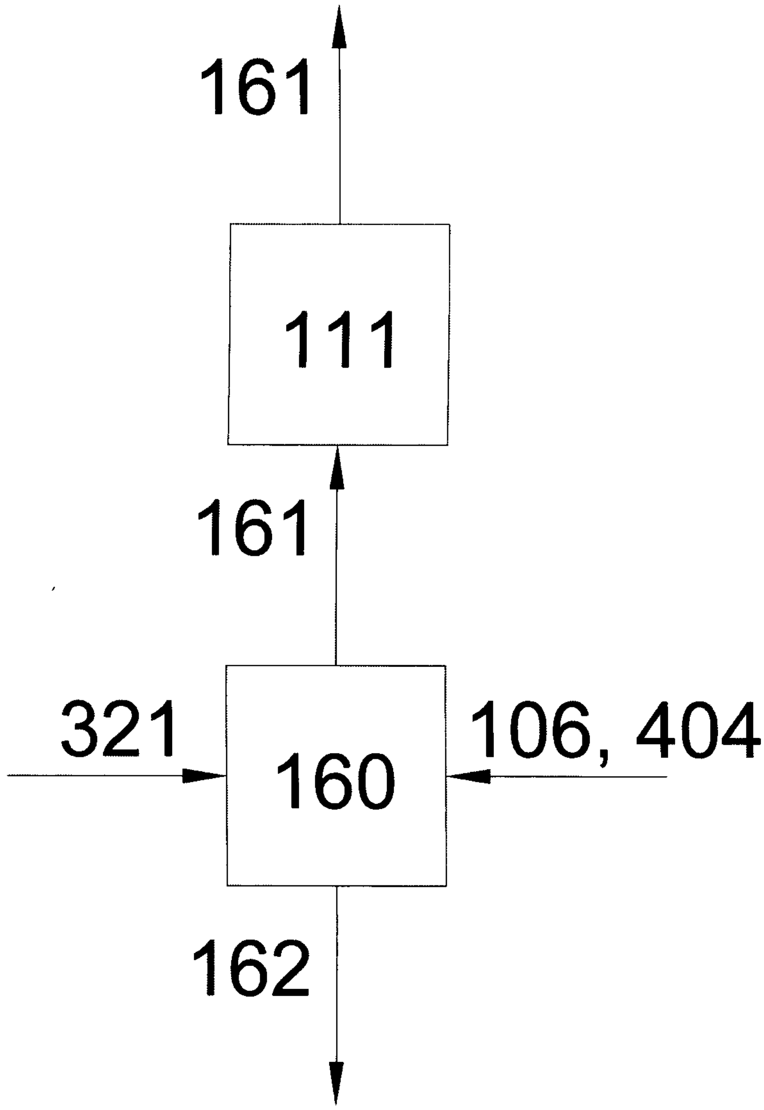

Figure 2E

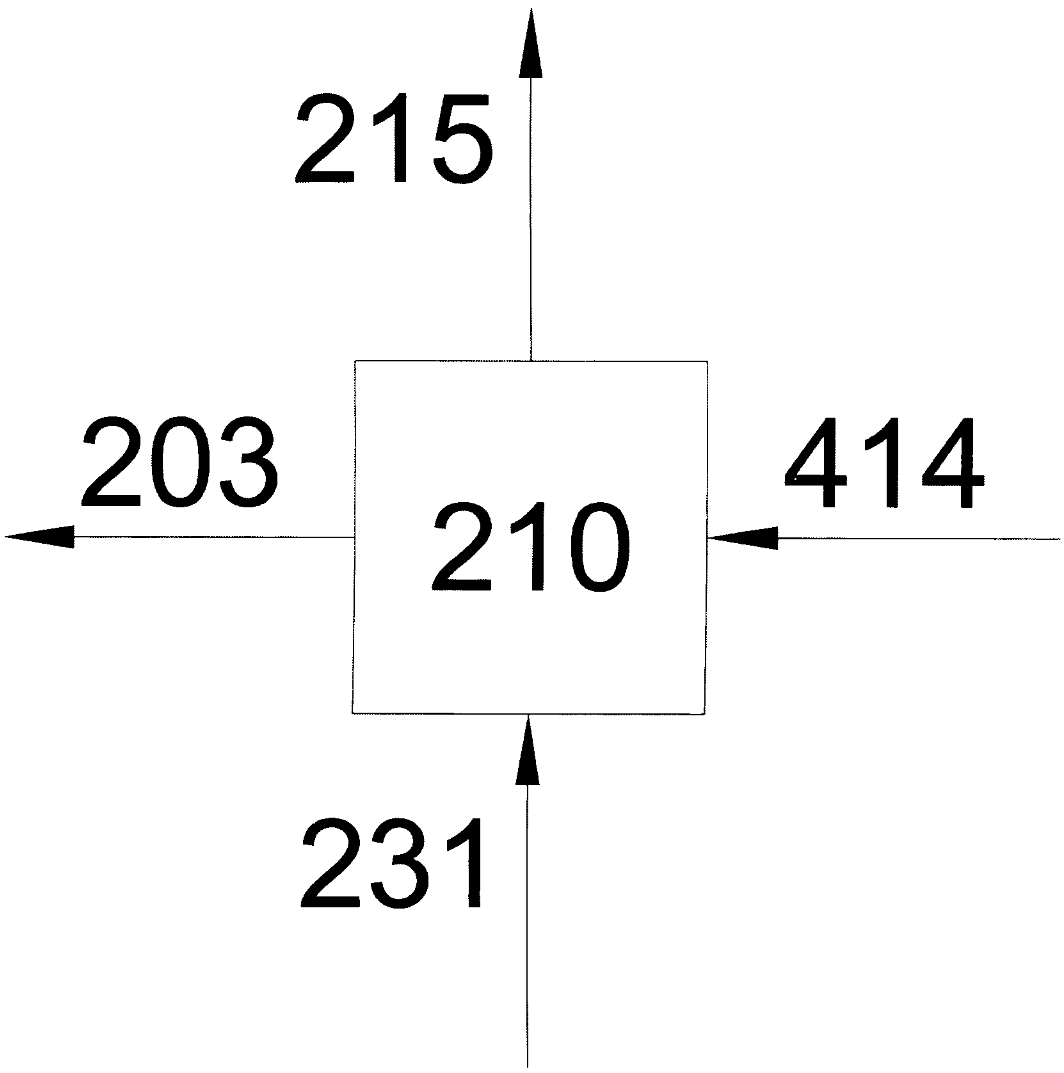

Figure 3A

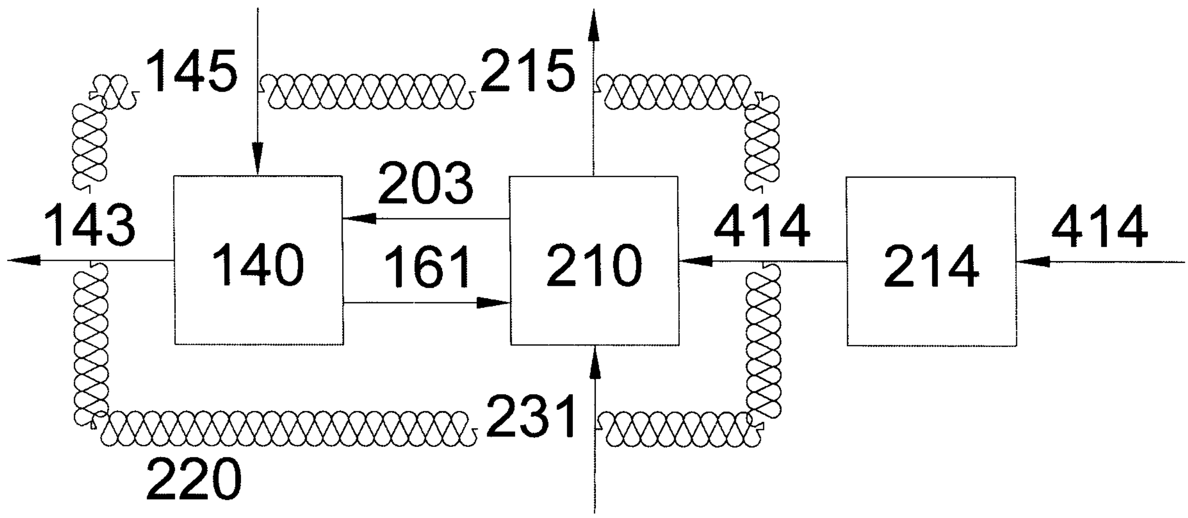

Figure 3B

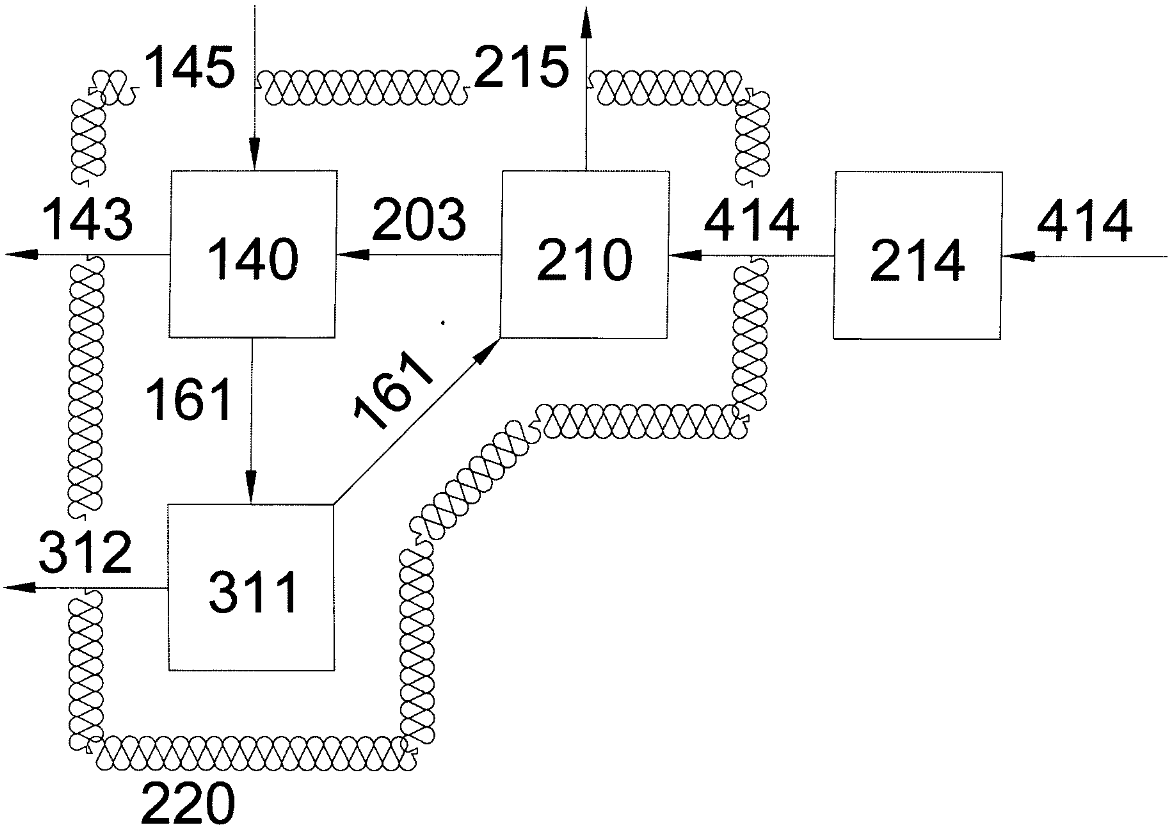

Figure 3C

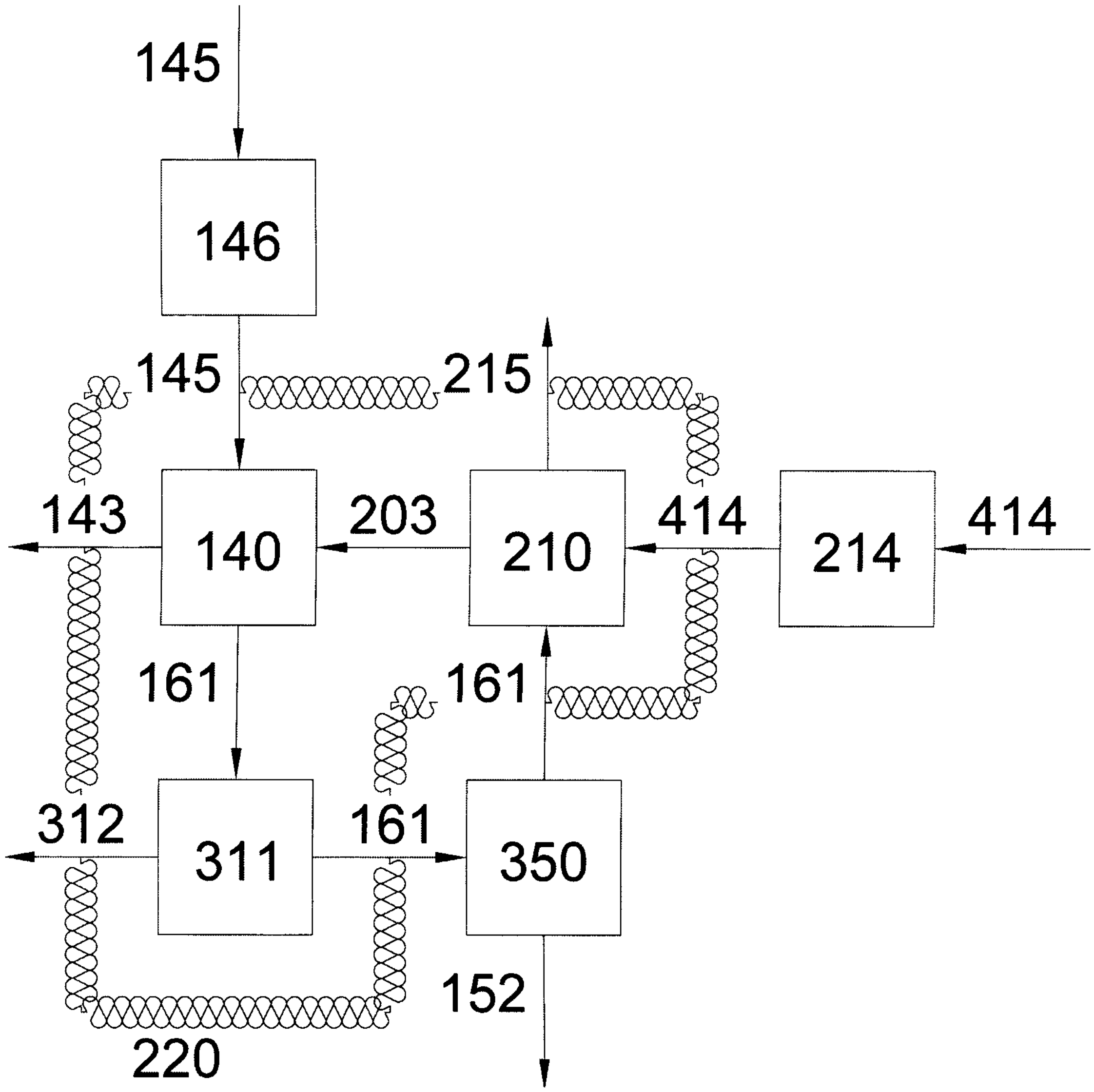
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Figure 3D

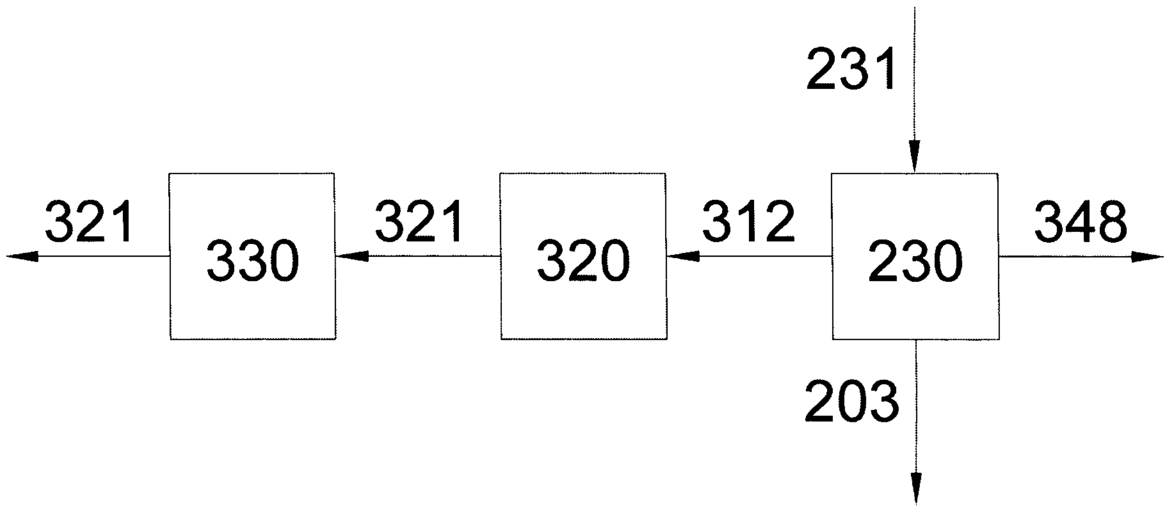

Figure 3E

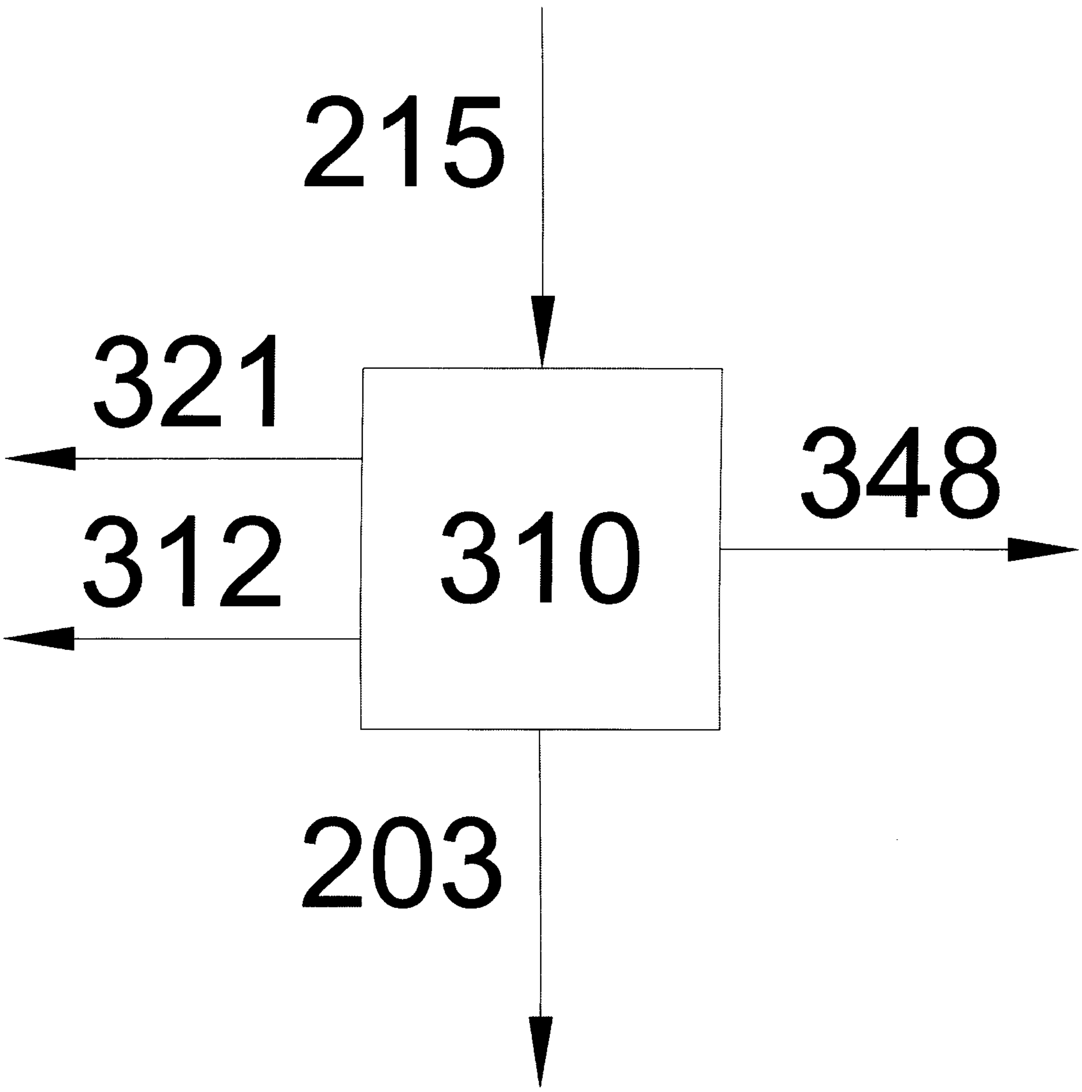

Figure 4A

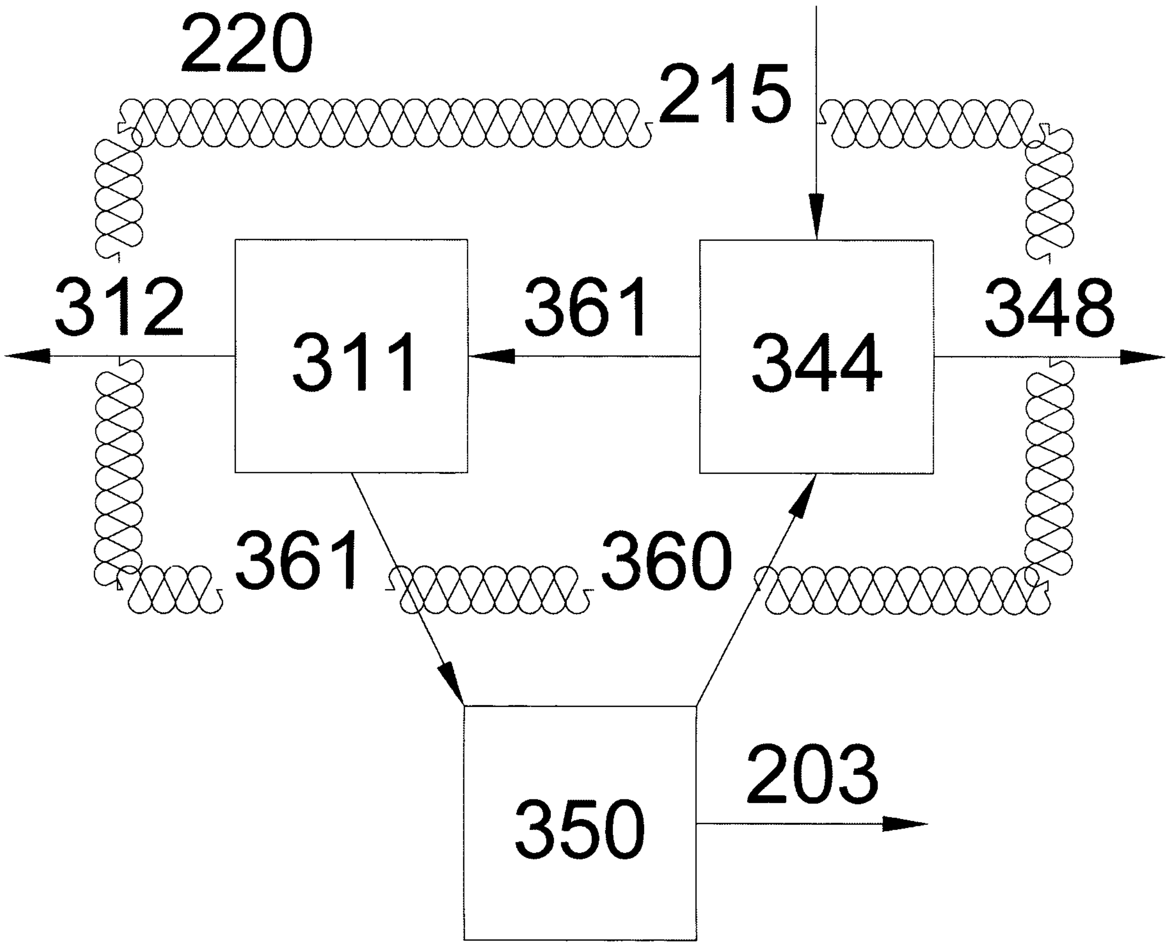

Figure 4B

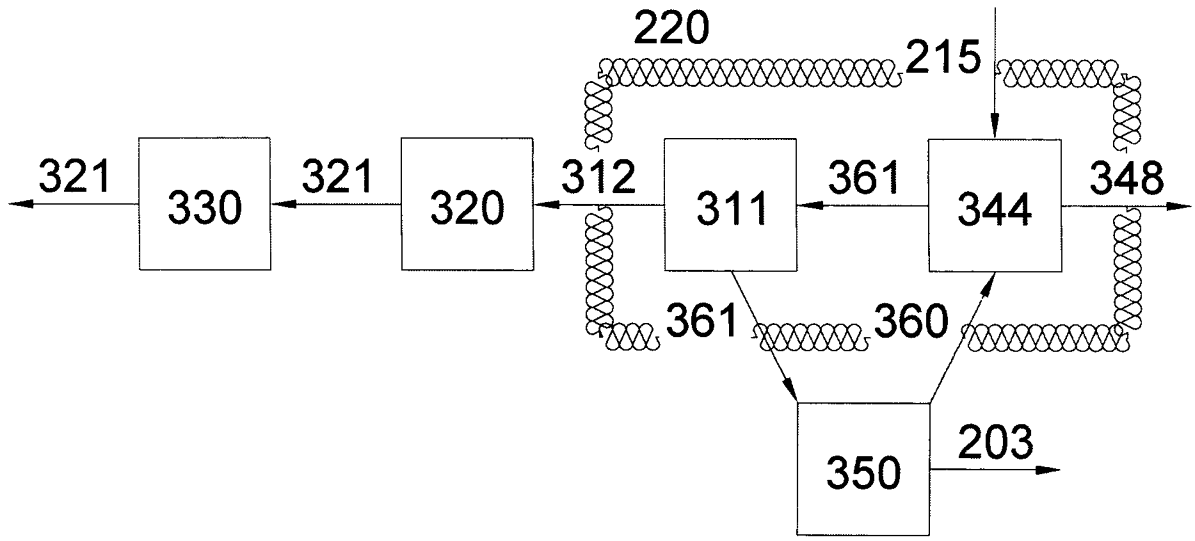

Figure 4C

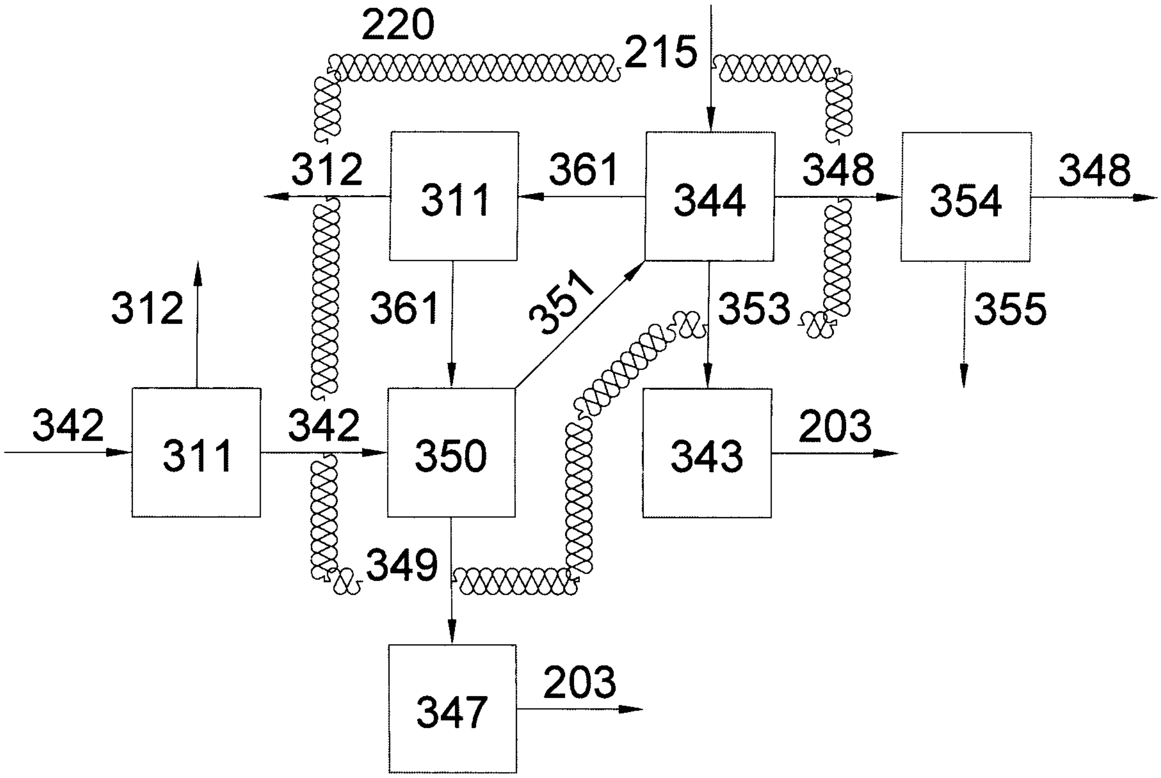
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Figure 4D

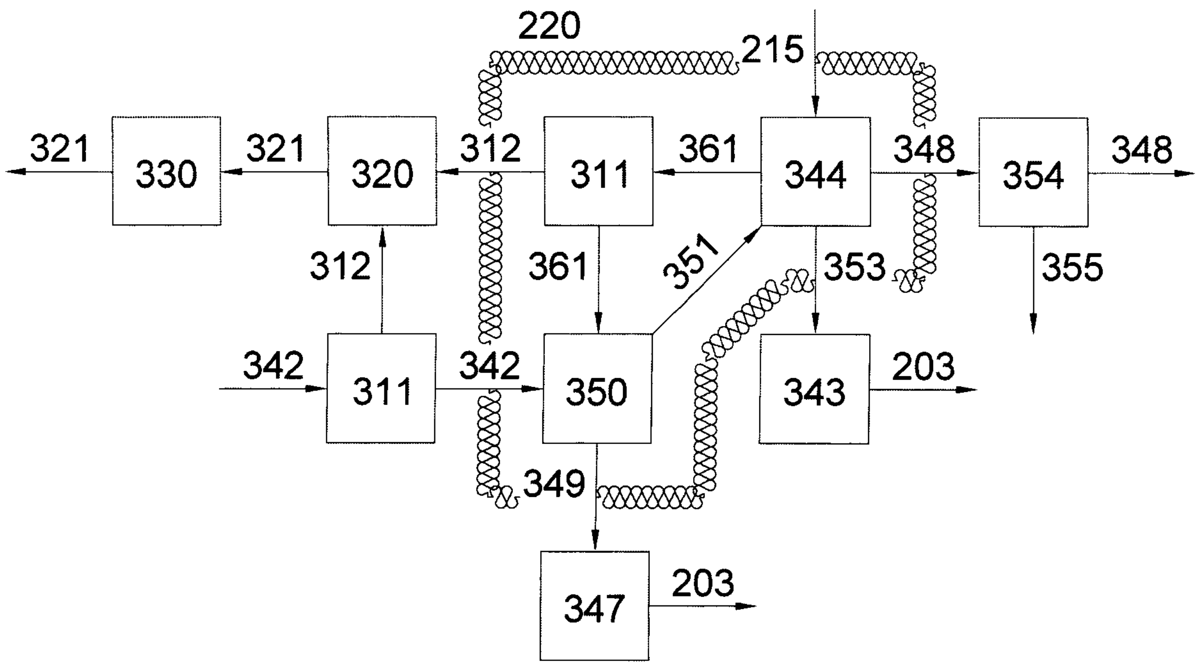
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Figure 4E

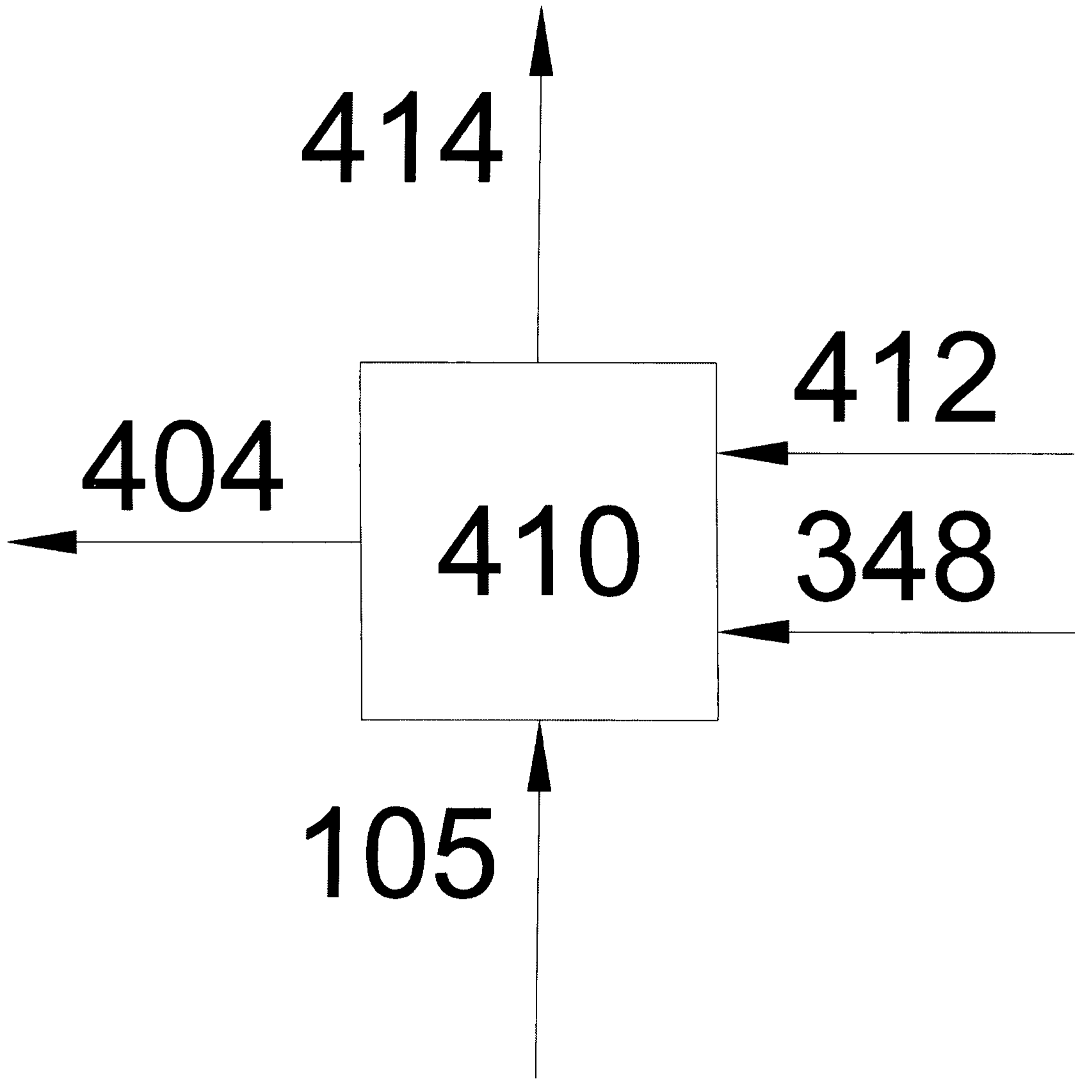

Figure 5A

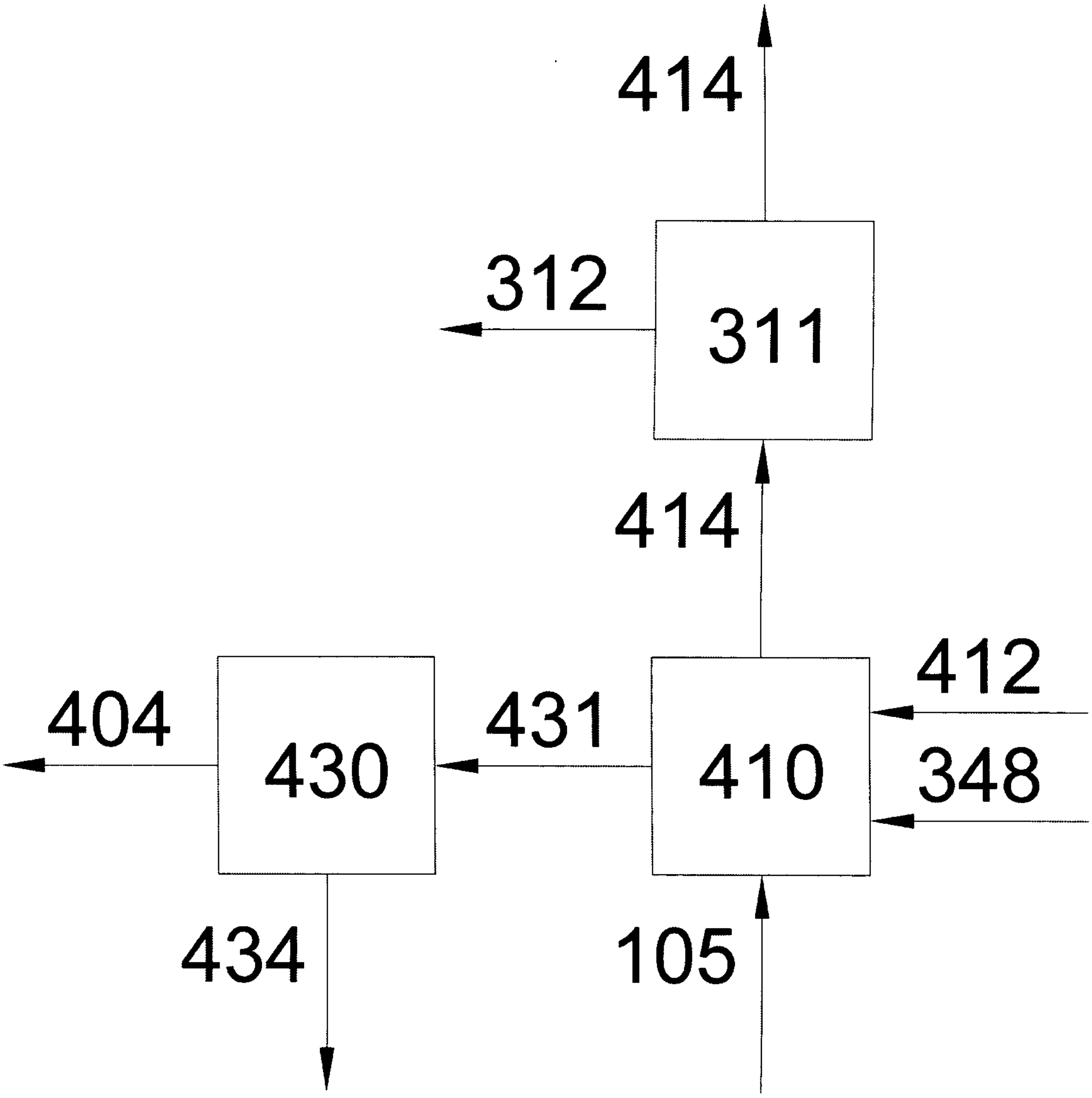

Figure 5B

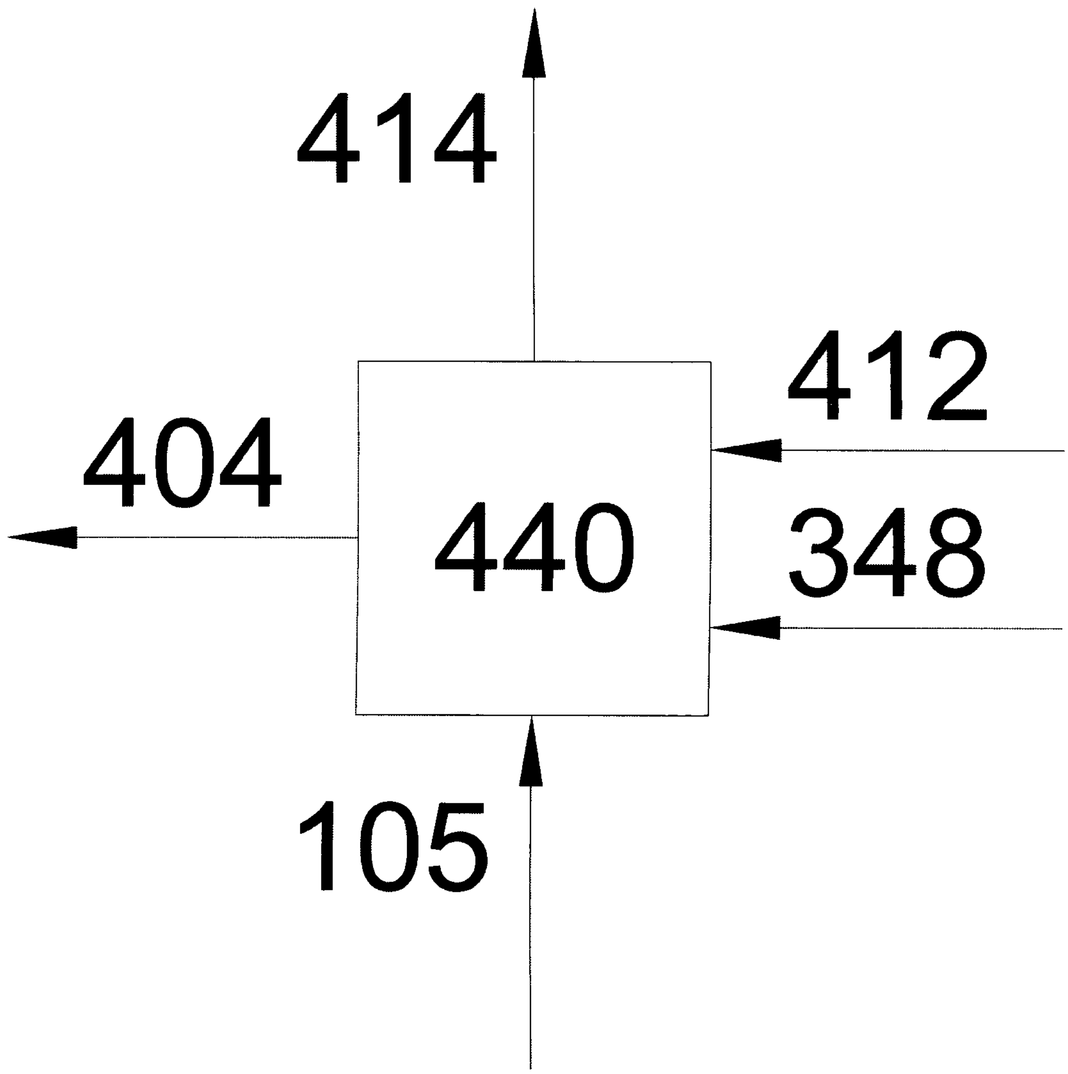

Figure 5C

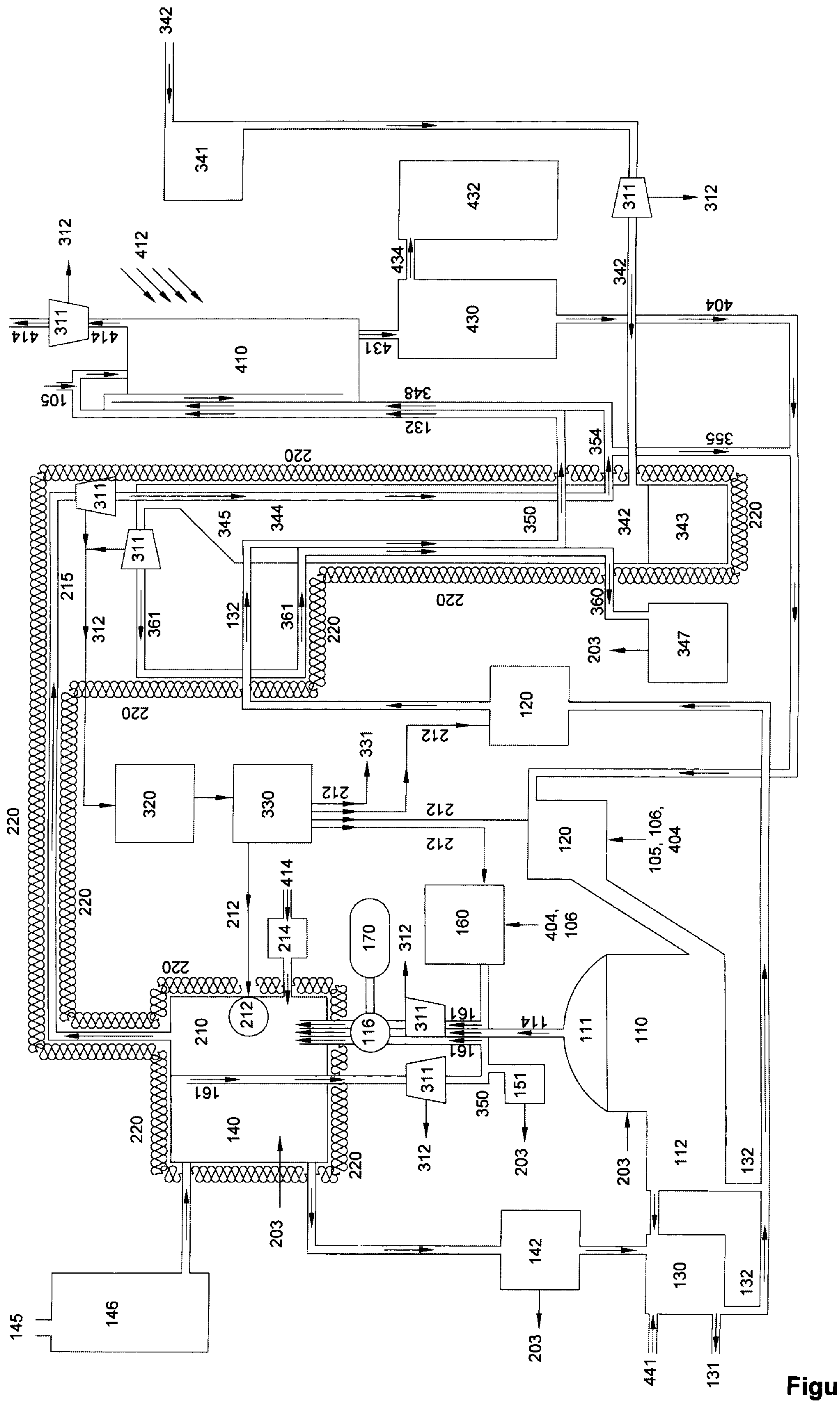
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Figure 6

RELATÓRIO DE PESQUISA INTERNACIONAL

Depósito internacional Nº
PCT/BR2012/000040

A. CLASSIFICAÇÃO DO OBJETO

C02F 11/04 (2006.01), C05F 17/02 (2006.01), C05F 15/00 (2006.01)

De acordo com a Classificação Internacional de Patentes (IPC) ou conforme a classificação nacional e IPC

B. DOMINIOS ABRANGIDOS PELA PESQUISA

Documentação mínima pesquisada (sistema de classificação seguido pelo símbolo da classificação)

C02F 11/04 (2006.01), C05F 17/02 (2006.01), C05F 15/00 (2006.01)

Documentação adicional pesquisada, além da mínima, na medida em que tais documentos estão incluídos nos domínios pesquisados

Brazilian Patents Database (SINPI), Portal CAPES

Base de dados eletrônica consultada durante a pesquisa internacional (nome da base de dados e, se necessário, termos usados na pesquisa)

Epo-Internal (EPODOC), PAJ, USPTO, DIALINDEX

C. DOCUMENTOS CONSIDERADOS RELEVANTES

Categoria*	Documentos citados, com indicação de partes relevantes, se apropriado	Relevante para as reivindicações Nº
Y	US 2008050800 A1 (MCKEEMAN TREVOR [US]; KARR GREG [US]; VADLANI PRAVEEN [US] **28 de fevereiro de 2008 (2008-02-28)** **Veja resumo, parágrafos 0004,0005,0017,0019,0020,0022,0040 figuras 2,3,5,6.**	1-14, 16, 18, 19
Y	WO 2009158028 A2 (OFFERMAN JOHN D [US]; MCTAVISH HUGH [US]) **30 de dezembro de 2009 (2009-12-30)** **Veja resumo, páginas1-6, 8-11, 14, 20; reivindicações 1-2, 4-6, 11, 13, 15, 17, figura 1.**	1-14, 16, 18, 19
Y	US 20100105127 A1 (GINSBURG MARTIN A [US] **29 de abril de 2010 (2010-04-29)** **Veja parágrafos** 0017-0021, 0024, 0031, 0091, 0092, **figura** 2C	1-14, 16, 18, 19

☐ Documentos adicionais estão listados na continuação do Quadro C ☒ Ver o anexo de família da patentes

* Categorias especiais dos documentos citados:

"A" documento que define o estado geral da técnica, mas não é considerado de particular relevância.

"E" depósito ou patente anterior, mas publicada após ou na data do depósito internacional.

"L" documento que pode lançar dúvida na(s) reivindicação(ões) de prioridade ou na qual é citado para determinar a data de outra citação ou por outra razão especial (como especificado).

"O" documento referente a uma divulgação oral, uso, exibição ou por outros meios.

"P" documento publicado antes do depósito internacional, porém posterior a data de prioridade reivindicada.

"T" documento publicado depois da data de depósito internacional, ou de prioridade e que não conflita com o depósito, porém citado para entender o princípio ou teoria na qual se baseia a invenção.

"X" documento de particular relevância; a invenção reivindicada não pode ser considerada nova e não pode ser considerada envolver uma atividade inventiva quando o documento é considerado isoladamente.

"Y" documento de particular relevância; a invenção reivindicada não pode ser considerada envolver atividade inventiva quando o documento é combinado com um outro documento ou mais de um, tal combinação sendo óbvia para um técnico no assunto.

"&" documento membro da mesma família de patentes.

Data da conclusão da pesquisa internacional	Data do envio do relatório de pesquisa internacional:
08 de maio de 2012	150512

Nome e endereço da ISA/**BR**

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US 2008050800 A1	2008-02-28	nenhum	
WO 2009158028 A2	2009-12-30	US 2009321349 A1 WO 2009158028 A3	2009-12-31 2010-05-06
US 20100105127 A1	2010-04-29	nenhum	

INTERNATIONAL SEARCH REPORT

International application N°
PCT/BR2012/000040

A. CLASSIFICATION OF SUBJECT MATTER
C02F 11/04 (2006.01), C05F 17/02 (2006.01), C05F 15/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C02F 11/04 (2006.01), C05F 17/02 (2006.01), C05F 15/00 (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Brazilian Patents Database (SINPI), Portal CAPES

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Epo-Internal (EPODOC), PAJ, USPTO, DIALINDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claims N°
Y	US 2008050800 A1 (MCKEEMAN TREVOR [US]; KARR GREG [US]; VADLANI PRAVEEN [US] 28 February 2008 (2008-02-28) See abstract, paragraphs 0004, 0005, 0017, 0019, 0020, 0022, 0040, figures 2, 3, 5, 6.	1-14, 16, 18, 19
Y	WO 2009158028 A2 (OFFERMAN JOHN D [US]; MCTAVISH HUGH [US]) 30 December 2009 (2009-12-30) See abstracts, pages 1-6, 8-11, 14, 20, claims 1-2, 4-6, 11, 13, 15, 17, figure 1.	1-14, 16, 18, 19
Y	US 20100105127 A1 (GINSBURG MARTIN A [US] 29 Apr. 2010 (2010-04-29) See paragraphs 0017-0021, 0024, 0031, 0091, 0092, figure 2C	1-14, 16, 18, 19

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to stablish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority claimed
"T" later document published after the internationa filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvius to a person skilled in the art
"&" document member ot the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 May 2012	150512

Name and mailing address of the ISA/**BR**
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application N°
PCT/BR2012/000040

Patent documents cited in search report	Publication date	Patent family members	Publication date
US 2008050800 A1	2008-02-28	None	
WO 2009158028 A2	2009-12-30	US 2009321349 A1 WO 2009158028 A3	2009-12-31 2010-05-06
US 20100105127 A1	2010-04-29	None	