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# (54) A MAGNETIC DEVICE FOR DISSOCIATION OF MOLECULES OF A COMBUSTIBLE SUBSTANCE IN THE LIQUID STATE AND A MAGNETIC SYSTEM FOR TREATING A COMBUSTIBLE SUBSTANCE IN THE LIQUID STATE

(57) A magnetic device (1) for dissociation of molecules of a combustible substance in the liquid state, comprising: a first container (2) which is made of an amagnetic material; a second container (3) which is made of an amagnetic material; the first container (2) and the second container (3) being arranged facing one another; a crossing channel (4) to be crossed by a combustible substance in the liquid state; a first permanent magnet (5) and a second permanent magnet (6) which are arranged in the first chamber (2a) flanked to one another; a third permanent magnet (7) and a fourth permanent magnet (8) which are arranged in the second chamber (3a) flanked to one another; a first separating element (9) which is made of an amagnetic material and which is interposed between the first permanent magnet (5) and the second permanent magnet (6) in order to separate them one from the other; a second separating element (10) which is made of an amagnetic material and which is interposed between the third permanent magnet (7) and the fourth permanent magnet (8) in order to separate them one from the other. The first permanent magnet (5) with the third permanent magnet (7) and the second permanent magnet (6) with the fourth permanent magnet (8), having a magnetic induction value comprised between 0.42 and 0.60 Tesla, are arranged facing one another in such a way as to generate, respectively, a magnetic field having field lines directed in a first direction (X1) which is perpendicular to the flow of the combustible substance in the liquid state in the crossing channel (4) and a magnetic field having field lines directed in a second direction (X2) which is opposite the first direction (X1).

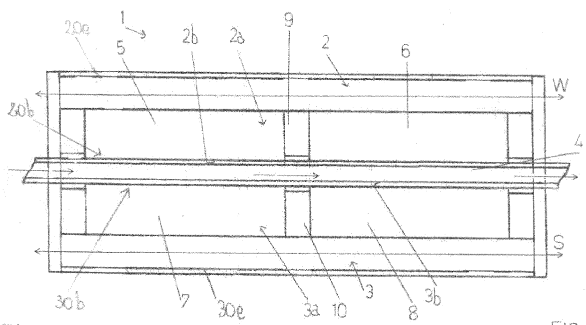

FIG 1

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## Description

**[0001]** The present invention relates to the technical sector concerning the dissociation of molecules of a combustible substance in the liquid state. In particular, the present invention relates to a magnetic device for dissociation of molecules of a combustible substance in the liquid state, i.e. the splitting of the inter-molecular bonds and intra-molecular bonds, and to a magnetic system for treating a combustible substance in liquid state to be inserted into a motor-driven vehicle.

**[0002]** Today, a large percentage of atmospheric pollution derives from the pollution caused by motor vehicles.

**[0003]** During the combustion of the combustible substance, motor vehicles emit a series of polluting substances, for example non-combusted hydrocarbons, nitrogen oxides, carbon monoxide, particulate and carbon dioxide ($CO_2$).

**[0004]** In recent years, containing the atmospheric pollution caused by motor vehicles has been done using catalysers, which push the exhaust gas to a further combustion with the aim of newly producing carbon dioxide and water instead of other polluting substances.

**[0005]** However, in using catalysers it is advantageous to fuel the engines with lead-free fuel, as the lead would lead to the gradual and irreversible "coating" of the active sites of the catalyser making it no longer available for carrying out the desired reaction.

**[0006]** Further, as the catalysers are not able to activate at ambient temperature, the mufflers of the motor vehicles have been modified in such a way as to reach, in the shortest time possible, from starting up the engine a temperature of at least 300-350 degrees centigrade.

**[0007]** Consequently, catalysers are practically ineffective in limiting the emissions of pollutant substance of the motor vehicles for short journeys, which are punctuated by pauses.

**[0008]** In the light of the above, the aim of the present invention consists in obviating the above-mentioned drawbacks.

**[0009]** The above-mentioned aim has been obtained by a magnetic device for dissociation of molecules of a combustible substance in the liquid state according to claim 1 and by means of a magnetic system for treating a combustible substance in liquid state to be inserted into a motor-driven vehicle for combustion thereof according to claim 13.

**[0010]** During the passage of the combustible substance in the liquid state along the crossing channel, the molecules are advantageously affected by the magnetic attraction force determined by the first permanent magnet, the second permanent magnet, the third permanent magnet and the fourth permanent magnet. The magnetic attraction force has an intensity such as to weaken the force existing between atoms of the molecules of the combustible substance in the liquid state.

**[0011]** The weakening or breaking of the bond existing between the atoms of the molecules of the combustible substance in the liquid state, which leads to the dissociation of the molecules of the combustible substance in the liquid state, is proportional to the crossing time of the combustible substance in the liquid state through the crossing channel, and therefore, to the crossing velocity, i.e. the time of exposure of the combustible substance in the liquid state to the magnetic field determined by the first, second, third and fourth permanent magnet.

**[0012]** In the passage along the crossing channel, from the portion struck by the first and third permanent magnet to the portion struck by the second and fourth permanent magnet, the electrons of the atoms of the molecules of the combustible substance in the liquid state are affected by a magnetic inversion which leads to a process of collision of one electron against another and to the emission of photons which make possible the two types of dissociation, inter-molecular and intra-molecular.

**[0013]** While not wishing to be constrained to any physical theory, should the magnetic device, object of the present invention, be arranged upstream of the combustion chamber of a motor-driven vehicle, the inventors have determined that, following the weakening and/or breaking of the bonds existing between the atoms and molecules of the combustible substance, in the combustion chamber a uniform mixture is created between the molecules of the combustible substance and the oxygen. This phenomenon improves the detonating capacities of the combustible substance in the combustion process, guaranteeing better oxidation of the chemical elements, thus-treated, constituting the combustible substance. In this way, there will be very small-size molecules which will enable the obtaining of a uniform blending with oxygen in an ordered system.

**[0014]** With the increasing of the degree of blending between the combustible substance and the oxygen, the non-combusted residues will be reduced and the heat force in favour of the work force will increase, generating greater energy efficiency of any engine fuelled by the combustible substance.

**[0015]** Consequently, given a same combustible substance and oxygen used during the combustion process which takes part in the combustion chamber of the motor-driven vehicle, with the magnetic device and the magnetic system of the present invention, a reduction of the production of non-combusted hydrocarbons has been demonstrated, and thus of particulate, of nitrogen oxides and of carbon dioxide ($CO_2$) limiting the phenomenon of partial oxidation of the combustible substance.

**[0016]** Further, by generating great energy efficiency a better kilometre per litre performance results, i.e: a same litre of fuel will last a greater number of kilometres. There will, therefore, be a reduction in $CO_2$ equal to the percentage of increase of kilometres travelled for each litre of fuel.

**[0017]** Further, it is well known that there are ferrous particles in a combustible substance in the liquid state.

**[0018]** Therefore, in the case in which, during the use of the magnetic device, the crossing channel is crossed by a combustible substance to be inserted into a motor-driven vehicle for combustion thereof, these ferrous particles will be attracted by the first, second, third and the fourth permanent magnet along the crossing channel, at the portion of first opening interposed between the first and the third permanent magnet and the portion of second opening interposed between the second and the fourth permanent magnet.

**[0019]** In other words, in the above-mentioned areas a deposit of ferrous particles will be created, which, over time, might compromise the correct operation of the magnetic device itself, as the accumulation of ferrous particles might lead to a region having an outgoing or incoming magnetic flow such as to interfere with the magnetic field created by the first and third permanent magnet and the second and fourth permanent magnet.

**[0020]** As a consequence, there is a need for periodic maintenance of the magnetic device that, using the magnetic device that is the object of the present invention, can be done in safety and in a simple and rapid way.

**[0021]** In the example case, it will be sufficient to decouple the third coupling profile of the covering element from the first coupling profile and from the second coupling profile and to access the third through-opening so as to remove the crossing channel for the purpose of removing the deposit of ferrous particles.

**[0022]** Specific embodiments of the invention will be described in the following part of the present description, according to what is set down in the claims and with the aid of the accompanying tables of drawings, in which:

- figure 1, figure 2 and figure 3 are illustrations in transversal section, taken from different section lines, of the magnetic device that is the object of the present invention;

- figure 4 and figure 5 are views of the force lines of the magnetic field determined by the first permanent magnet, by the second permanent magnet, by the third permanent magnet and by the fourth permanent magnet.

**[0023]** With reference to the appended tables of drawings, reference numeral (1) denotes a magnetic device for dissociation of molecules of a combustible substance in the liquid state, comprising: a first container (2) which is made of an amagnetic material, which is conformed in such a way as to define a first chamber (2a) and which comprises a first through-opening (2b) for accessing the first chamber (2a); a second container (3) which is made of an amagnetic material, which is conformed in such a way as to define a second chamber (3a) and which comprises a second through-opening (3b) for accessing the second chamber (3a). The first container (2) and the second container (3) are arranged facing one another so that the first through-opening (2b) and the second through-opening (3b) are in proximity of one another and so that the first chamber (2a) and the second chamber (3a) are in communication with one another via the first through-opening (2b) and the second through-opening (3b).

**[0024]** The first container (2) comprises a first coupling profile (210) and the second container (3) comprises a second coupling profile (310); the first coupling profile (210) and the second coupling profile (310) define between them a third through-opening (320) which is in communication with the first through-opening (2b) and the second through-opening (3b) so that the first through-opening (2b) and the second through-opening (3b) are in communication with the outside environment via the third through-opening (320).

**[0025]** The magnetic device (1) further comprises: a crossing channel (4) which is insertable in the third through-opening (320) in order to be arranged interposed between the first through-opening (2b) and the second through-opening (3b) so as to be crossed by a combustible substance in the liquid state; a covering element (330) comprising a third coupling profile (340) conformed to couple to the first coupling profile (210) and to the second coupling profile (310) in such a way as to define a form coupling; a first permanent magnet (5) and a second permanent magnet (6) which are arranged in the first chamber (2a) flanked to one another and in such a way that the lateral walls of the first chamber (2a) laterally contain the first permanent magnet (5) and the second permanent magnet (6) so as to maintain them in position; a third permanent magnet (7) and a fourth permanent magnet (8) which are arranged in the second chamber (3a) flanked to one another and in such a way that the lateral walls of the second chamber (3a) laterally contain the third permanent magnet (7) and the fourth permanent magnet (8) so as to maintain them in position; a first separating element (9) which is made of an amagnetic material and which is arranged in the first chamber (2a) and interposed between the first permanent magnet (5) and the second permanent magnet (6) in order to separate them one from the other; a second separating element (10) which is made of an amagnetic material and which is arranged in the second chamber (3a) and interposed between the third permanent magnet (7) and the fourth permanent magnet (8) in order to separate them one from the other.

**[0026]** The first permanent magnet (5) and the third permanent magnet (7) have a magnetic induction value comprised between 0.42 and 0.60 Tesla and which are arranged facing one another and in such a way that the relative north pole and the relative south pole generate a magnetic field having field lines directed in a first direction (X1) which is perpendicular to the flow of the combustible substance in the liquid state in the crossing channel (4) and the second permanent magnet (6) and the fourth permanent magnet (8) have a magnetic induction value comprised between 0.42 and 0.60 Tesla and which are arranged facing one another and in such a way that the relative north pole and the relative south pole generate a magnetic field having field lines directed in a second direction (X2) which is opposite the first direction (X1) and which is perpendicular to the flow of the combustible substance in the liquid state in the crossing channel (4). The magnetic field generated by the relative north pole and the relative south pole of each permanent magnet (5, 6, 7, 8) determines a magnetic attraction force having an intensity such as to weaken a force existing between atoms of the molecules of the combustible substance in the liquid state, during the passage of the combustible substance in the liquid state along the crossing channel (4) (see figure 1, in which, in the crossing channel (4), arrows are included which indicate the movement direction of the combustible substance in the liquid state along the crossing channel (4)).

**[0027]** Dissociation of molecules can be taken to mean the breaking of inter-molecular bonds and the intra-molecular bonds of the molecules themselves.

**[0028]** The first, second, third and fourth permanent magnet (5, 6, 7, 8) maintain the properties thereof up to 120°C.

**[0029]** The crossing channel (4) can be a tube made of a plastic material, for example PVC.

**[0030]** The magnetic device (1), object of the present invention, comprises only the first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8)

**[0031]** In other words, the inventors have demonstrated that the embodiment comprising only the above-mentioned four permanent magnets (5, 6, 7, 8) ensures optimal performance of the magnetic device (1) during use thereof.

**[0032]** The first chamber (2a) and the second chamber (3a) ensure the maintaining in position, respectively, of the first and the second permanent magnet (5, 6) and of the third and the fourth permanent magnet (7, 8), both during the step of assembly/deassembly and during the use of the magnetic device (1).

**[0033]** In detail, the first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8) have a magnetic induction value of 0.42 Tesla.

**[0034]** Further, with particular reference to figure 4, the first separating element (9) and the second separating element (10) are arranged in such a way that at the position thereof is an area not affected by: the field lines, directed in the first direction (X1), of the magnetic field generated by the north pole and by the south pole of the first permanent magnet (5) and of the third permanent magnet (7); the field lines, directed in the second direction (X2), of the magnetic field generated by the north pole and by the south pole of the second permanent magnet (6) and of the fourth permanent magnet (8).

**[0035]** In other words, during the passage of the combustible substance in the liquid state along the crossing channel (4), the combustible substance in the liquid state will first strike the field lines directed in the first direction (X1), the above-mentioned area and the field lines directed in the second direction (X2).

**[0036]** In this way, successively to the above-mentioned area, the combustible substance in the liquid state will undergo a magnetic inversion in the field lines of the relative magnetic field.

**[0037]** The area can be understood as an area that is not affected by the field lines generated by the first permanent magnet (5), by the second permanent magnet (6), by the third permanent magnet (7) and by the fourth permanent magnet (8) and wherein the combustible substance in the liquid state will undergo a magnetic inversion in the field lines which will lead to a turbulence in the magnetic field.

**[0038]** In detail, the first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8) are arranged in such a way that the relative north pole and the relative south pole determine a mutual magnetic attraction force having an intensity such as to weaken and/or break the chemical bond existing between atoms of the molecules of the combustible substance in the liquid state, during the passage of the combustible substance in the liquid state along the crossing channel (4).

**[0039]** The magnetic device (1), object of the present invention, comprises only the first separating element (9) and the second separating element (10).

**[0040]** The inventors have demonstrated that the embodiment comprising only the first separating element (9) and the second separating element (10) ensures optimal performance of the magnetic device (1) during use thereof.

**[0041]** With particular reference to figures 1 and 4, during the passage of the combustible substance in the liquid state along the crossing channel (4), the field lines generated by the first permanent magnet (5), by the second permanent magnet (6), by the third permanent magnet (7) and by the fourth permanent magnet (8) are orientated perpendicularly to the movement direction of the flow of the combustible substance in the liquid state.

**[0042]** The relative north pole and the relative south pole of each permanent magnet (5, 6, 7, 8) can further generate a non-uniform magnetic field having circular field lines such as to reinforce and stabilise the intensity of the magnetic attraction force which affects combustible substance in the liquid state, during the passage of the combustible substance in the liquid state along the crossing channel (4).

**[0043]** In the field of chemistry, the term "dissociation" means the partial or total splitting of a molecule.

**[0044]** By way of example, a combustible substance can be understood to be a combustible substance for an internal combustion engine, either petrol or diesel.

**[0045]** In this case, considering that in a combustible substance in the liquid state there can be ferrous particles, the arrangement of the first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8) is such as to enable a capture of those ferrous particles at the area of the first permanent magnet (5) and of the third permanent magnet (7), which are opposite one another.

**[0046]** Consequently, there is an improvement of the functioning of the magnetic device (1), object of the present invention, since when the combustible substance in the liquid state reaches the area of the second permanent magnet (6) and of the fourth permanent magnet (8), which are opposite one another, it will be free of ferrous particles.

**[0047]** Figures 4 and 5 illustrate force lines of the magnetic field determined by the relative north pole and south pole of the first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8).

**[0048]** Taking into consideration the use of the magnetic device (1) upstream of the engine of a motor-driven vehicle, the inventors have found the following advantages:

- reduction of the production of particulate following the combustion process;
- reduction of the average consumption of combustible substance;
- reduction of the presence of the residues of the combustion process in the injectors and in the combustion chamber;
- reduction of impurities having a bacterial load (with a relative limitation of proliferation thereof) in the injection pump;
- quick start-up of the engine even at low temperatures.

**[0049]** As a demonstration of the foregoing, the inventors have conducted testing using, as a vehicle, an "Iveco Stralis 450 CV" (Euro 5 and registered in 2009) having 950000 km on the tachometer, an automatic gearbox, pump injectors for injection of the diesel fuel into the combustion chamber and an average consumption of diesel fuel of 2.8 km per litre.

**[0050]** The tests were carried out to detect the diesel fuel consumption, the production of particulate and the general motor efficiency, using the magnetic device (1) that is the object of the present invention upstream of the engine and during the movement activity of the vehicle over a period of 18 months. Therefore the value mentioned in the following is a mean value, determined by the average of the values detected in a month under variable load conditions and variable atmospheric conditions.

**[0051]** A reduction in the particulate production was noted comprised between 60% and 70% and an average consumption of diesel fuel at most of 3.6 km per litre.

**[0052]** Further tests were carried out using as a vehicle a "Scania series 4 164 480 CV" (Euro 3 and registered in 2003) having 1100000 km on the tachometer, a manual gearbox, traditional injectors for the injection of the diesel fuel in the combustion chamber and an average consumption of diesel fuel of 2.7 km per litre.

**[0053]** The tests were carried out to detect the diesel fuel consumption, the production of particulate and the general motor efficiency, using the magnetic device (1) that is the object of the present invention upstream of the engine and during the movement activity of the vehicle over a period of one month. Therefore the value mentioned in the following is a mean value, determined by the average of the values detected in a month under variable load conditions and variable atmospheric conditions.

**[0054]** A reduction in the particulate production was noted comprised between 70% and 80% and a maximum consumption of diesel fuel at most of 3.4 km per litre.

**[0055]** Further tests were carried out using as a vehicle a "Fiat Ducato maxi 2800 TD" having 297000 km on the tachometer, a manual gearbox, pump injectors for injection of the diesel fuel in the combustion chamber and an average consumption of diesel fuel of 9 km per litre.

**[0056]** The tests were carried out to detect the diesel fuel consumption, the production of particulate and the general motor efficiency, using the magnetic device (1) that is the object of the present invention upstream of the engine and during the movement activity of the vehicle over a period of 24 months. Therefore the value mentioned in the following is a mean value, determined by the average of the values detected in a month under variable load conditions and variable atmospheric conditions.

**[0057]** A reduction in the particulate production was noted comprised between 70% and 83% and a maximum consumption of diesel fuel at most of 12 km per litre.

**[0058]** The first container (2) is conformed in such a way as to internally define the first chamber (2a) (see figures 2 and 3).

**[0059]** The first container (2) can extend along a first longitudinal extension axis (W) (see figures 2 and 3).

**[0060]** The first chamber (2a) and the first through-opening (2b) can also extend along a first longitudinal extension axis (W) (see figures 2 and 3).

**[0061]** The second container (3) is conformed in such a way as to internally define the second chamber (3a) (see figures 2 and 3).

**[0062]** The second container (3) can extend along a second longitudinal extension axis (S).

**[0063]** The first chamber (3a) and the first through-opening (3b) can also extend along the second longitudinal extension axis (S).

**[0064]** The first longitudinal extension axis (W) and the second longitudinal extension axis (S) can be parallel to one another.

**[0065]** With particular reference to figure 2, the first longitudinal extension axis (W) and the second longitudinal extension axis (S) are illustrated as exiting from the table of drawings.

**[0066]** By way of example, the crossing channel (4) can receive an infeed pipe of combustible substance at the engine of a motor-driven vehicle.

**[0067]** The crossing channel (4) can have a circular section.

**[0068]** The first permanent magnet (5) and the second permanent magnet (6) can be arranged in the first chamber (2a) in such a way as to be flanked along the first longitudinal extension axis (W) (see figure 1).

**[0069]** The second permanent magnet (7) and the fourth permanent magnet (8) can be arranged in the second chamber (3a) in such a way as to be flanked along the second longitudinal extension axis (S) (see figure 1).

**[0070]** The first permanent magnet (5) and the third permanent magnet (7) can be arranged in such a way as to be arranged facing to one another with respect to the crossing channel (4) (see figure 1).

**[0071]** The second permanent magnet (6) and the fourth permanent magnet (8) can be arranged in such a way as to be arranged facing to one another with respect to the crossing channel (4) (see figure 1).

**[0072]** With particular reference to figure 1, the position of the first permanent magnet (5) of the second permanent magnet (6) in the first chamber (2a) and the position of the third permanent magnet (7) and of the fourth permanent magnet (8) in the second chamber (3a) is such as to delineate a design having a rectangular shape.

**[0073]** In other words, still with reference to figure 1, the first permanent magnet (5) and the fourth permanent magnet (8) are positioned along a diagonal of the design having a rectangular shape; while the second permanent magnet (6) and the third permanent magnet (7) are positioned along the other diagonal of the designed having a rectangular shape.

**[0074]** The covering element (330) preferably comprises a first end and a second end and each forms an angled wall (109, 110); the first coupling profile (210) forms a first protrusion (107); the second coupling profile (310) forms a second protrusion (108).

**[0075]** The coupling between an angled wall (109) and the first protrusion (107) and between the other angled wall (110) and the second protrusion (108) determine a form coupling between them.

**[0076]** The covering element (330) can form a T-shape so as to insert between the first coupling profile (210) and the second coupling profile (310).

**[0077]** In this way, the covering element (330) advantageously prevents the possible nearing between the first protrusion (107) and the second protrusion (108) which might be determined by effect of the magnetic attraction force determined by the first, second, third and fourth permanent magnet (5, 6, 7, 8).

**[0078]** The first container (2) can form a C-shape and the relative ends (20b) define the first through-opening (2b) (see figures 2 and 3).

**[0079]** The second container (3) can form a C-shape and the relative ends (30b) define the second through-opening (3b) (see figures 2 and 3). The relative ends (20b, 30b) are interposed between, respectively, the first permanent magnet (5) and the third permanent magnet (7) and between the second permanent magnet (6) and the fourth permanent magnet (8) so as to maintain them in a distanced position from one another.

**[0080]** The first permanent magnet (5) and the second permanent magnet (6) advantageously abut the relative ends (20b) of the first container (2) and the third permanent magnet (7) and the fourth permanent magnet (8) abut the relative ends (30b) of the second container (3) in such a way that there is not contact between, respectively, the first and the third permanent magnet (5, 7) and the second and the fourth permanent magnet (6, 8).

**[0081]** In this way, there is no need to interpose additional material in the first chamber (2a) and in the second chamber (3a), following insertion, respectively of the first and the second permanent magnet (5, 6) and of the third and the fourth permanent magnet (7, 8), in such a way as to be positioned interposed between the first and the third permanent magnet (5, 7) and between the second and the fourth permanent magnet (6, 8).

**[0082]** The first container (2) and the second container (3) can be arranged so as to be mutually specular (see figures 1, 2 and 3).

**[0083]** The first permanent magnet (5) and the second permanent magnet (6) are preferably arranged in the first chamber (2a) so as to abut at least an end of the relative ends (20b) and the third permanent magnet (7) and the fourth permanent magnet (8) are arranged in the second chamber (3a) so as to abut at least an end of the relative ends (30b) (see figures 2 and 3).

**[0084]** In detail, the first permanent magnet (5) and the second permanent magnet (6) are arranged in the first chamber (2a) so as to be in contact with at least an end of the relative ends (20b); while the third permanent magnet (7) and the fourth permanent magnet (8) are arranged in the second chamber (3a) so as to be in contact with at least an end of the relative ends (30b) (see figures 2 and 3).

**[0085]** The first container (2), second container (3), first separating element (9) and the second separating element (10) are preferably made of a plastic material.

**[0086]** The first container (2), second container (3), first separating element (9) and the second separating element (10) are advantageously not affected by the magnetic attraction force determined by the first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8).

**[0087]** The first chamber (2a) and the second chamber (3a) can have a square or rectangular transversal section.

**[0088]** The first chamber (2a) e the second chamber (3a) can have a shape such as to determine a form coupling between the first chamber (2a) with the first permanent magnet (5) and the second permanent magnet (6) and between the second chamber (3a) with the third permanent magnet (7) and the fourth permanent magnet (8).

**[0089]** The first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8) preferably have a polygonal section.

**[0090]** The first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8) are advantageously conformed in such a way as to enable a form coupling with the first chamber (2a) and the second chamber (3a).

**[0091]** The section of the first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8) can be square or rectangular.

**[0092]** The first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8) can each define a parallelepiped having six faces.

**[0093]** According to a second embodiment, the magnetic device (1) preferably comprises: a first U-shaped plate (101) for cladding a first lateral face (102) of the first container (2) and of the second container (3), during use; a second U-shaped plate (103) for cladding a second lateral face (104), which is opposite the first lateral face (102), of the first container (2) and of the second container (3), during use; the first plate (101) and the second plate (103) being made of steel in order to screen the magnetic field determined by the first permanent magnet (5), by the second permanent magnet (6), by the third permanent magnet (7) and by the fourth permanent magnet (8) (see figure 3).

**[0094]** By screening the magnetic field, the magnetic attraction force generated is advantageously delimited internally of the magnetic device (1) itself, ensuring correct operation of the magnetic device (1) during use.

**[0095]** Further, the eventual dispersion of the magnetic flow is limited.

**[0096]** In a case where the magnetic device (1) is arranged upstream of an internal combustion engine, during use, the first plate (101) and the second plate (103) ensure that the magnetic field does not jeopardise or damage the metal parts of the engine.

**[0097]** The first plate (101) and the second plate (103) guarantee and increase in the magnetic attraction force between the permanent magnets (5, 6, 7, 8).

**[0098]** The first plate (101) and the second plate (103) can have a thickness value comprised between 0.8-1 mm.

**[0099]** The first container (2) can comprise a first side (20c) and a second side (20d) which are opposite one another and a third side (20e) which joins the first side (20c) and the second side (20) to one another (see figures 2 and 3).

**[0100]** The second container (3) can comprise a fourth side (30c) and a fifth side (30d) which are opposite one another and a sixth side (30e) which joins the fourth side (30c) and the fifth side (30d) to one another (see figures 2 and 3).

**[0101]** The first lateral face (102) is defined by the first side (20c), by the fourth side (30c) and by part of the third side (20e) and of the sixth side (30e); while the second lateral face (104) is defined by the second side (20d), by the fifth side (30d) and by part of the third side (20e) and of the sixth side (30e) (see figures 2 and 3).

**[0102]** The first plate (101) and the second plate (103) can be made of mild steel.

**[0103]** The first plate (101) and the second plate (103) can be arranged mutually specularly.

**[0104]** The magnetic device (1) can comprise: a first half-shell (11a) which is arranged so as to laterally envelop the first container (2) and the second container (3); a second half-shell (11b) which is arranged so as to laterally envelop the first container (2) and the second container (3); the first half-shell (11a) and the second half-shell (11b) being couplable to one another so as to internally contain the first container (2) and the second container (3) (see figure 3).

**[0105]** According to the second embodiment, the first half-shell (11a) is arranged so as to laterally envelop the first plate (101) and the second half-shell (11b) is arranged so as to laterally envelop the second plate (103); the first half-shell (11a) and the second half-shell (11b) are couplable to one another so as to internally contain the first container (2), the second container (3), the first plate (101) and the second plate (103) (see figure 3).

**[0106]** At the moment when it becomes necessary to carry out maintenance of the magnetic device (1), it will be sufficient to decouple the first half-shell (11a) and the second half-shell (11b), to remove the first plate (101) and the second plate (102) to decouple the third coupling profile (340) of the covering element (330) from the first coupling profile (210) and from the second coupling profile (310) and to access the third through-opening (320), so as to remove the crossing channel (4) for the purpose of removing the deposit of ferrous particles.

**[0107]** In this way, the deposit of ferrous particles is removed by the user without interacting with the first, second, third and fourth permanent magnet (5, 6, 7, 8) which remain inside, respectively, the first chamber (2a) and the second chamber (3a).

**[0108]** Further, by not moving the permanent magnets (5, 6, 7, 8), the ferrous particles will not be dispersed during the maintenance but will remain internally of the crossing channel (4) at the areas where they are deposited during the use of the magnetic device (1).

**[0109]** In detail, the inventors have demonstrated that excellent results can be obtained in the case in which the first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8) have a square or rectangular section and a length value comprised between 2-10 cm, the first separator element (9) and the second separator element (10) have, respectively, a length value comprised between 0.1-1 cm in the case in which: the first permanent magnet (5) and the second permanent magnet (6) are arranged in the first chamber (2a) in such a way as to be 1 cm away from the longitudinal ends of the first container (2); the third magnet (7) and the fourth magnet

(8) are arranged in the second chamber (3a) in such a way as to be 1 cm away from the longitudinal ends of the second container (3).

**[0110]** According to the second embodiment, the first container (2) can comprise a first attachment (105) which is arranged opposite the first opening (2b) and which comprises at least a hollow portion (105a) to dissipate the heat transmitted to the first permanent magnet (5) and to the second permanent magnet (6) by the combustible substance in the liquid state crossing the crossing channel (4) and the second container (3) can comprise a second attachment (106) which is arranged opposite the second opening (3b) and which comprises at least a second hollow portion (106a) to dissipate the heat transmitted to the third permanent magnet (7) and to the fourth permanent magnet (8) by the combustible substance in the liquid state crossing the crossing channel (4).

**[0111]** The first container (2) and the first attachment (105) can be made in a single body.

**[0112]** The second container (3) and the second attachment (106) can be made in a single body.

**[0113]** In detail, with reference to figure 3, the first chamber (2a) is interposed between the first attachment (105) and the first opening (2b).

**[0114]** The second chamber (3a) is interposed between the second attachment (106) and the second opening (3b).

**[0115]** The first container (2) and the second container (3) can be made in a single body.

**[0116]** A description follows of a magnetic system for treating a combustible substance in the liquid state to be inserted into a motor-driven vehicle for combustion thereof, also an object of the present invention, comprising: a magnetic device (1) according to any one of the preceding embodiments;

an internal combustion engine. The magnetic device (1) is connected in series and upstream of the internal combustion engine with respect to the advancement direction of the combustible substance in the liquid state in the crossing channel (4).

**[0117]** Il magnetic system, object of the present invention, guarantees better use of the energy of the combustible substance and, therefore, a combustion having a reduced production of waste and impurities in the combustion chamber and having a lower environment pollution impact.

**[0118]** In this way, there will be a uniform running of the engine over time.

## Claims

**1.** A magnetic device (1) for dissociation of molecules of a combustible substance in the liquid state, wherein:

it comprises a first container (2) which is made of an amagnetic material, which is conformed in such a way as to define a first chamber (2a) and which comprises a first through-opening (2b) for accessing the first chamber (2a);

it comprises a second container (3) which is made of an amagnetic material, which is conformed in such a way as to define a second chamber (3a) and which comprises a second through-opening (3b) for accessing the second chamber (3a);

the first container (2) and the second container (3) are arranged facing one another so that the first through-opening (2b) and the second through-opening (3b) are in proximity of one another and so that the first chamber (2a) and the second chamber (3a) are in communication with one another via the first through-opening (2b) and the second through-opening (3b);

the first container (2) comprises a first coupling profile (210);

the second container (3) comprises a second coupling profile (310);

the first coupling profile (210) and the second coupling profile (310) define between them a third through-opening (320) which is in communication with the first through-opening (2b) and the second through-opening (3b) so that the first through-opening (2b) and the second through-opening (3b) are in communication with the outside environment via the third through-opening (320);

it comprises a crossing channel (4) which is insertable in the third through-opening (320) in order to be arranged interposed between the first through-opening (2b) and the second through-opening (3b) so as to be crossed by a combustible substance in the liquid state;

it comprises a covering element (330) comprising a third coupling profile (340) conformed to couple to the first coupling profile (210) and to the second coupling profile (310) in such a way as to define a form coupling between them;

it comprises a first permanent magnet (5) and a second permanent magnet (6) which are arranged in the first chamber (2a) flanked to one another and in such a way that the lateral walls of the first chamber (2a) laterally contain the first permanent magnet (5) and the second permanent magnet (6) so as to maintain them in position;

it comprises a third permanent magnet (7) and a fourth permanent magnet (8) which are arranged in the second chamber (3a) flanked to one another and in such a way that the lateral walls of the second chamber (3a) laterally contain the third permanent magnet (7) and the fourth permanent magnet (8) so as to maintain them in position;

it comprises a first separating element (9) which

is made of an amagnetic material and which is arranged in the first chamber (2a) and interposed between the first permanent magnet (5) and the second permanent magnet (6) in order to separate them one from the other;
it comprises a second separating element (10) which is made of an amagnetic material and which is arranged in the second chamber (3a) and interposed between the third permanent magnet (7) and the fourth permanent magnet (8) in order to separate them one from the other;
the first permanent magnet (5) and the third permanent magnet (7) have a magnetic induction value comprised between 0.42 and 0.60 Tesla and which are arranged facing one another and in such a way that the relative north pole and the relative south pole generate a magnetic field having field lines directed in a first direction (X1) which is perpendicular to the flow of the combustible substance in the liquid state in the crossing channel (4);
the second permanent magnet (6) and the fourth permanent magnet (8) have a magnetic induction value comprised between 0.42 and 0.60 Tesla and are arranged facing one another and in such a way that the relative north pole and the relative south pole generate a magnetic field having field lines directed in a second direction (X2) which is opposite the first direction (X1) and which is perpendicular to the flow of the combustible substance in the liquid state in the crossing channel (4);
the magnetic field generated by the relative north pole and south pole of each permanent magnet (5, 6, 7, 8) determines a magnetic attraction force having an intensity such as to weaken a force existing between atoms of the molecules of the combustible substance in the liquid state, during the passage of the combustible substance in the liquid state along the crossing channel (4).

**2.** The magnetic device (1) of the preceding claim, wherein:

the covering element (330) comprises a first end and a second end and each forms an angled wall (109, 110);
the first coupling profile (210) forms a first protrusion (107);
the second coupling profile (310) forms a second protrusion (108);
the coupling between an angled wall (109) and the first protrusion (107) and between the other angled wall (110) and the second protrusion (108) determine a form coupling between them.

**3.** The magnetic device (1) of the preceding claim, wherein: the first container (2) forms a C-shape and the relative ends (20b) define the first through-opening (2b); the second container (3) has a C-shape and the relative ends (30b) define the second through-opening (3b); the relative ends (20b, 30b) being interposed between, respectively, the first permanent magnet (5) and the third permanent magnet (7) and between the second permanent magnet (6) and the fourth permanent magnet (8) so as to maintain them in a distanced position from one another.

**4.** The magnetic device (1) of the preceding claim, wherein:

the first permanent magnet (5) and the second permanent magnet (6) are arranged in the first chamber (2a) so as to abut at least an end of the relative ends (20b);
the third permanent magnet (7) and the fourth permanent magnet (8) are arranged in the second chamber (3a) so as to abut at least an end of the relative ends (30b).

**5.** The magnetic device (1) of any one of the preceding claims, wherein the first container (2), the second container (3), the first separating element (9) and the second separating element (10) are made of a plastic material.

**6.** The magnetic device (1) of any one of the preceding claims, wherein the first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8) have a polygonal section.

**7.** The magnetic device (1) of any one of the preceding claims, wherein: the first permanent magnet (5), the second permanent magnet (6), the third permanent magnet (7) and the fourth permanent magnet (8) each define a parallelepiped having six faces.

**8.** The magnetic device (1) of any one of the preceding claims, comprising: a first U-shaped plate (101) for cladding a first lateral face (102) of the first container (2) and of the second container (3), during use; a second U-shaped plate (103) for cladding a second lateral face (104), which is opposite the first lateral face (102), of the first container (2) and of the second container (3), during use; the first plate (101) and the second plate (103) being made of steel in order to screen the magnetic field determined by the first permanent magnet (5), by the second permanent magnet (6), by the third permanent magnet (7) and by the fourth permanent magnet (8).

**9.** The magnetic device (1) of any one of the preceding claims, comprising: a first half-shell (11a) which is arranged so as to laterally envelop the first container

(2) and the second container (3); a second half-shell (11b) which is arranged so as to laterally envelop the first container (2) and the second container (3); the first half-shell (11a) and the second half-shell (11b) being couplable to one another so as to internally contain the first container (2) and the second container (3).

**10.** The magnetic device (1) of any one of the preceding claims, wherein:

the first container (2) comprises a first attachment (105) which is arranged opposite the first opening (2b) and which comprises at least a hollow portion (105a) so as to dissipate the heat transmitted to the first permanent magnet (5) and to the second permanent magnet (6) by the combustible substance in the liquid state crossing the crossing channel (4);
the second container (3) comprises a second attachment (106) which is arranged opposite the second opening (3b) and which comprises at least a second hollow portion (106a) so as to dissipate the heat transmitted to the third permanent magnet (7) and to the fourth permanent magnet (8) by the combustible substance in the liquid state crossing the crossing channel (4).

**11.** The magnetic device (1) of the preceding claim, wherein:

the first container (2) and the first attachment (105) are made in a single body;
the second container (3) and the second attachment (106) are made in a single body.

**12.** The magnetic device of any one of the preceding claims, wherein the first container (2) and the second container (3) are made in a single body.

**13.** A magnetic system for treating a combustible substance in liquid state to be inserted into a motor-driven vehicle for combustion thereof, comprising:

a magnetic device (1) according to any one of the preceding claims;
an internal combustion engine;
the magnetic device (1) being connected in series and upstream of the internal combustion engine with respect to the advancement direction of the combustible substance in the liquid state in the crossing channel (4).

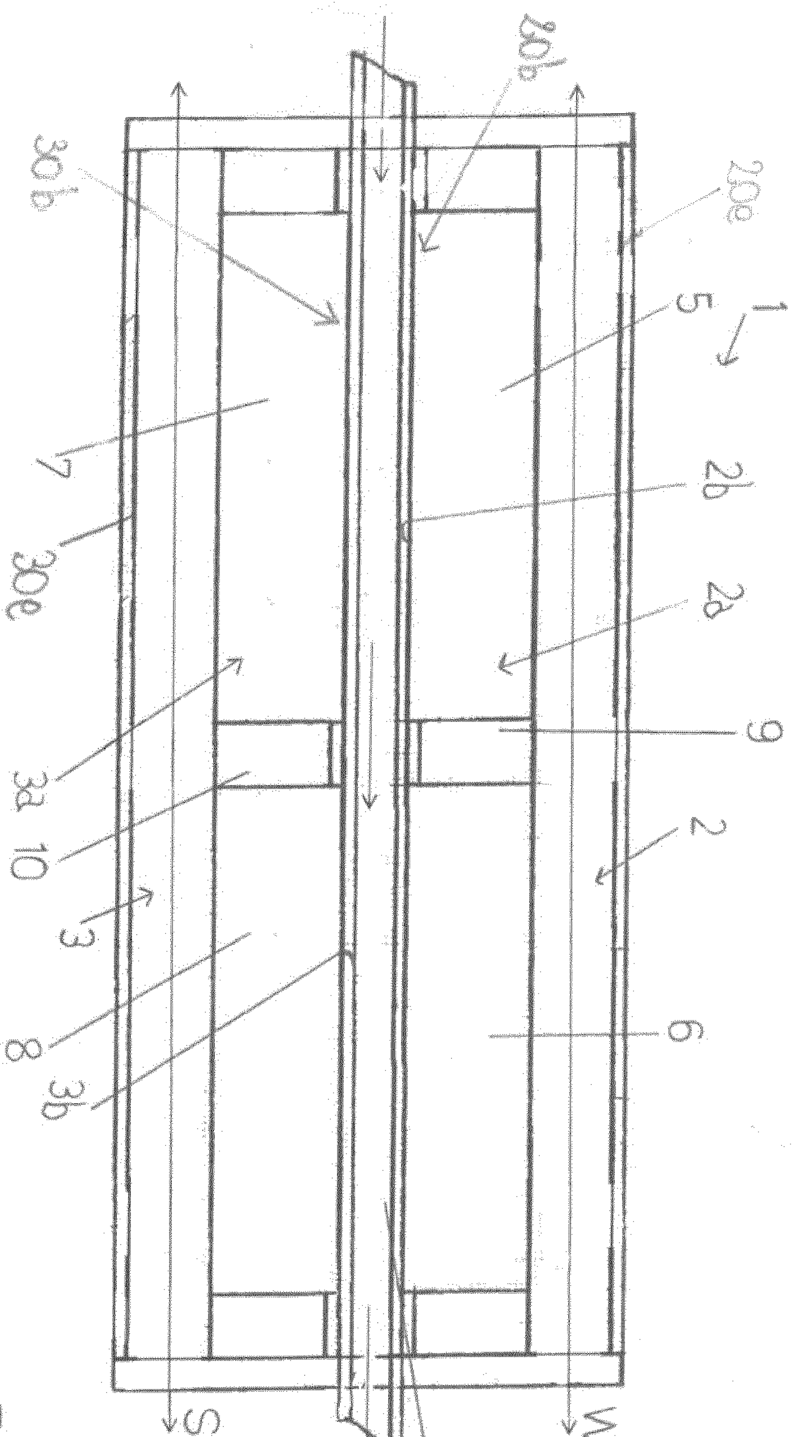


FIG 1

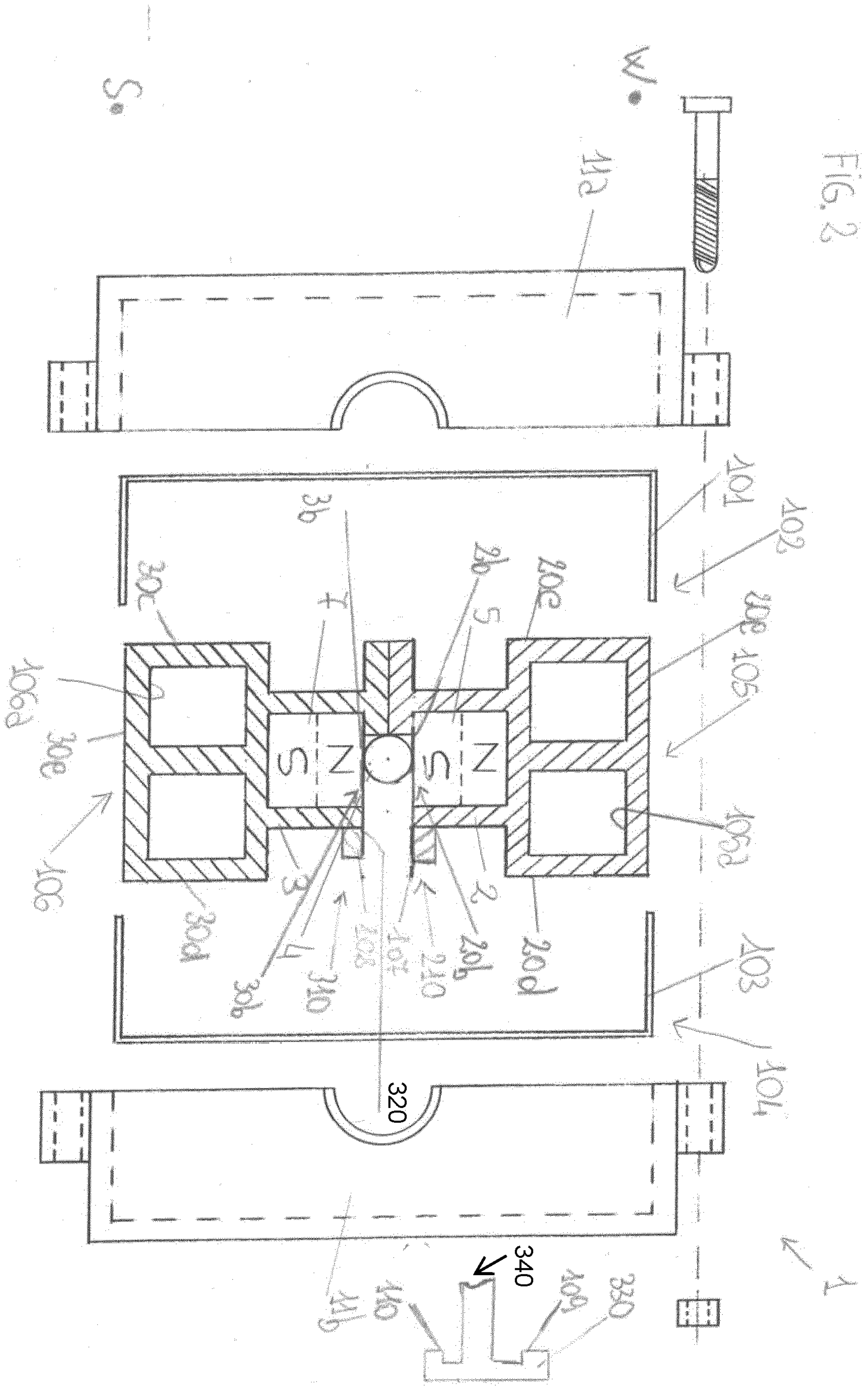


FIG. 2

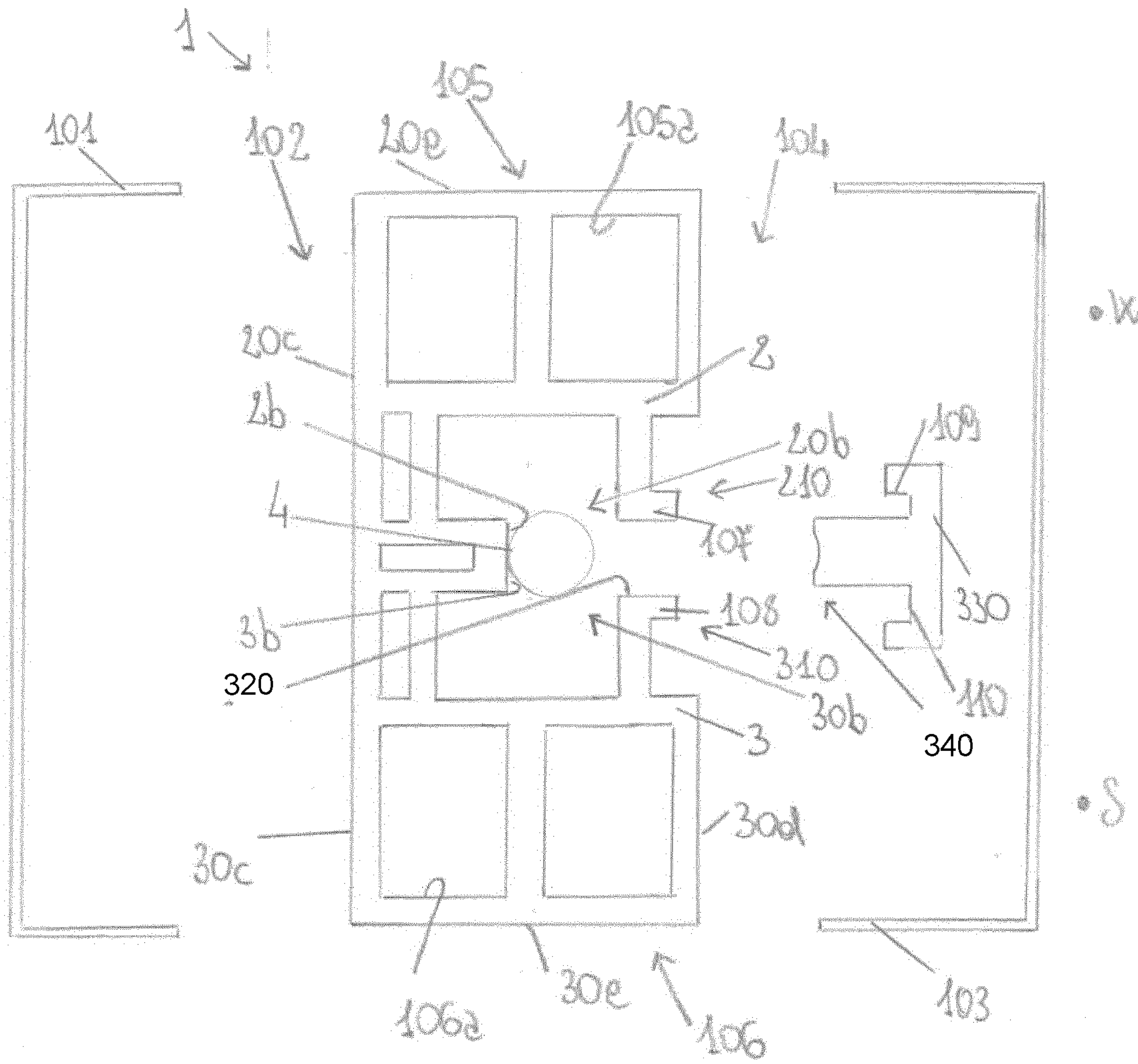
1
101
102
105
20e
105a
104
W
20c
2
2b
20b
210
109
4
107
108
330
3b
310
320
30b
110
340
3
S
30d
30c
106a
30e
106
103

FIG.3

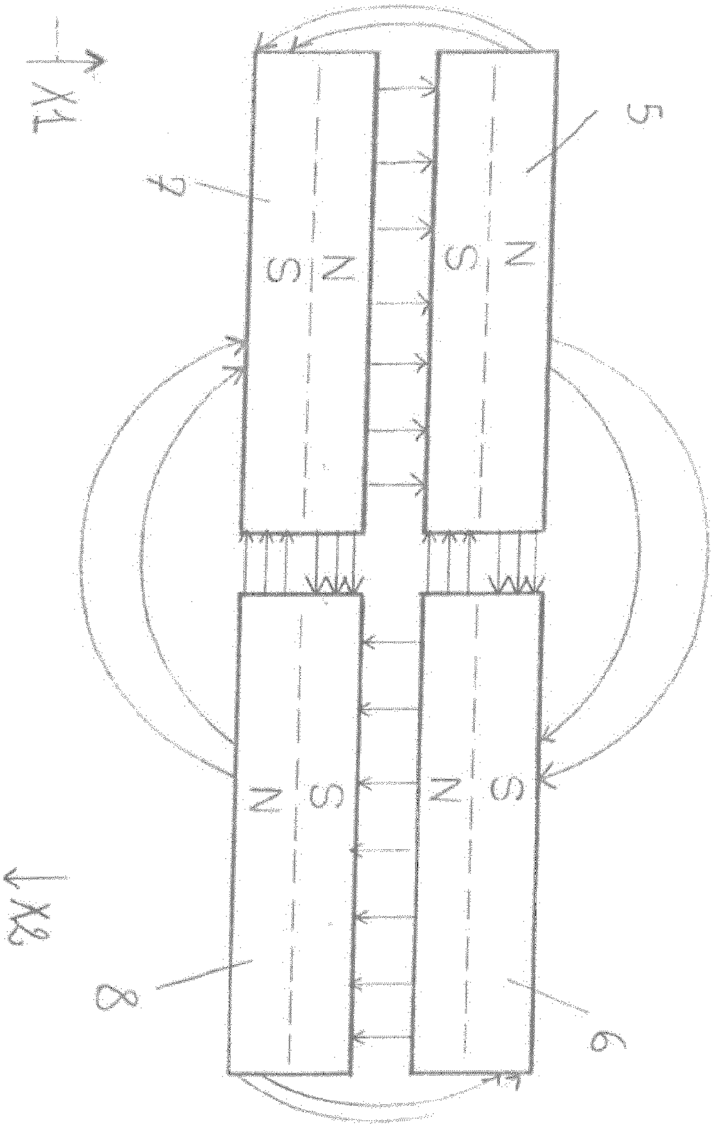


FIG. 4

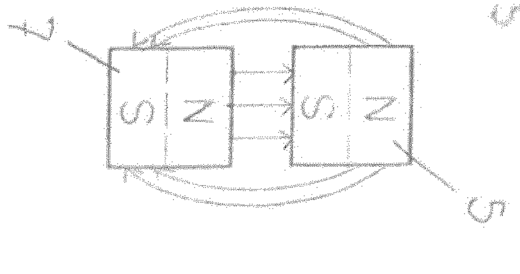


FIG. 5

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Application Number
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