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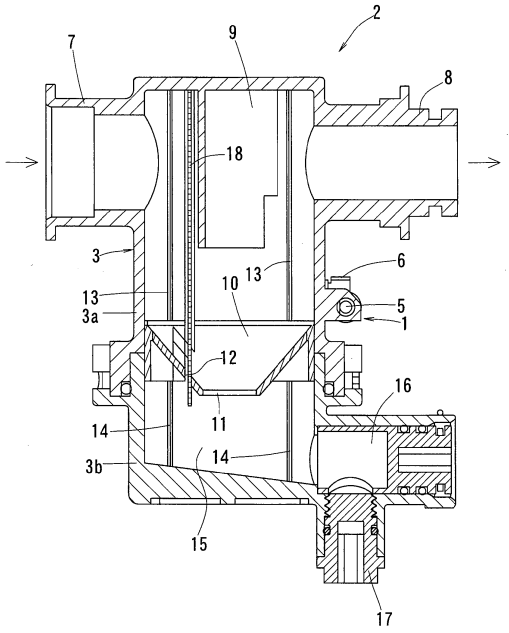
(54) MAGNETIC MATERIAL COLLECTING MECHANISM

(57) A magnetic material collecting mechanism is provided which facilitates the collection of magnetic materials, and incudes a main body 3 to which a shaft body 5 is provided, and in which a fluid containing magnetic materials flows; magnets 4 disposed on the outside of the main body 3; and a magnet holder 6 that pivots the magnets 4 about the shaft body 5, between an adhered state in which the magnets 4 are in contact with the outer surface of the main body 3, and a separated state in which the magnets 4 are separated from the outer surface of the main body 3. The magnetic materials attracted to the inner surface of the main body 3 when the magnets 4 are in the adhered state are separated from the inner surface of the main body 3 by switching the adhered state of the magnets 4 to the separated state, and the separated magnetic materials are collected.

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a magnetic material collecting mechanism used in a device such as a foreign matter removing device for removing magnetic materials in a fluid.

BACKGROUND ART

[0002] For example, in heating devices using a fluid such as hot water as a heating medium, the heating circuits through which the fluid is circulated tend to be constituted by iron pipes, and magnetic materials such as iron dust could be mixed into the fluid from the inner walls of the iron pipes. Since magnetic materials could cause malfunction of the pumps for circulating the fluid, it is necessary to remove magnetic materials in the fluid.

[0003] As a device for removing magnetic materials in a fluid, for example, the below-identified Patent Document 1 proposes the following device.

[0004] In the device of Patent Document 1, a fluid flowing in through an inflow port is dispersed when passing through a filter cartridge 14 disposed in a first chamber 11, and the fluid velocity is reduced. Also, magnets 18 retained by a C-shaped retaining member 21 are disposed on the outer wall of a second chamber 15 disposed under the first chamber 11. The magnetic materials in the fluid are attracted by the magnets 18.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0005] Patent document 1: US Patent Application Publication No. 2014/0367340

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] In the device of Patent Document 1, by dismounting the magnets from the second chamber together with the retaining member, the magnetic materials attracted by the magnets fall into the lower portion of the second chamber, and are collected. After collecting the magnetic materials, the magnets while being retained by the retaining member are again attached to the second chamber. Since, at this time, the dismounted retaining member with the magnets could be lost, it is necessary to take a loss preventing measure, e.g., attach a string to the retaining member with the magnets, and fix the string to the second chamber. This complicates work by a user.

[0007] In view of the above, it is an object of the present invention to provide a magnetic material collecting mechanism which facilitates the collection of magnetic materials.

MEANS FOR SOLVING THE PROBLEMS

[0008] In order to achieve the above object, the present invention provides a magnetic material collecting mechanism comprising: a main body to which a shaft body is provided, and in which a fluid containing magnetic materials flows; a magnet disposed on an outside of the main body; and a magnet holder configured to pivot the magnet about the shaft body, between an adhered state in which the magnet is in contact with an outer surface of the main body, and a separated state in which the magnet is separated from the outer surface of the main body, wherein the magnetic material collecting mechanism is configured such that magnetic materials attracted to an inner surface of the main body when the magnet is in the adhered state are separated from the inner surface of the main body by switching the adhered state of the magnet to the separated state, and the separated magnetic materials are collected.

[0009] With this arrangement, since by simply pivoting the magnet holder about the shaft body, it is possible to switch one to the other of the adhered state and the separated state of the magnet, there is no risk of losing parts, and magnetic materials can be collected easily.

[0010] In the above arrangement, the shaft body may be provided horizontally, the magnet holder may have insertion holes through which the shaft body is inserted, and the magnet holder may be configured to pivot between the adhered state and the separated state.

[0011] With this arrangement, since the pivoting mechanism of the magnet holder has a simple structure, there is a cost advantage.

[0012] In all of the above arrangements, the main body may have, in the outer surface of the main body, a recess with which the magnet is in contact in the adhered state, and the recess may have an edge comprising a stepped portion configured such that the magnet or the magnet holder comes into contact with the stepped portion when the magnet holder pivots.

[0013] With this arrangement, since the magnet holder is temporarily fixed by the contact of the stepped portion and the magnet or the magnet holder, it is possible to prevent the magnet holder in the adhered state from unexpectedly pivoting toward the separated state.

[0014] In all of the above arrangements, a resistance portion may be formed on a side surface of the main body, the resistance portion being configured to abut against the magnet holder in the adhered state, thereby applying pivoting resistance to the magnet holder.

[0015] With this arrangement, since the magnet holder is temporarily fixed by the contact of the resistance portion and the magnet holder, it is possible to prevent the magnet holder in the adhered state from unexpectedly pivoting toward the separated state.

[0016] In all of the above arrangements, the main body may be provided with a magnetic member configured to

be attracted to the magnet in the adhered state, and apply pivoting resistance to the magnet holder.

[0017] With this arrangement, since the magnet holder is temporarily fixed by the attracting force between the magnet and the magnetic member, it is possible to prevent the magnet holder in the adhered state from unexpectedly pivoting toward the separated state.

[0018] In the arrangement in which the insertion holes are formed, the main body may be formed with an abutment portion configured to abut against an outer surface of a lower end portion of the magnet holder in the adhered state, thereby blocking pivoting motion of the magnet holder, the insertion holes may be elongated holes elongated in a vertical direction when the magnet holder is in the adhered state, and the magnetic material collecting mechanism may be configured such that the shaft body is located at vertical central portions of the insertion holes in the adhered state; and the shaft body is located at lower ends of the insertion holes in a state in which abutment between the abutment portion and the magnet holder is released by sliding the magnet holder upward; and the shaft body is located at upper ends of the insertion holes in the separated state of the magnet.

[0019] With this arrangement, it is possible to smoothly release the locked state of the magnet holder due to the abutment portion. Also, by moving the shaft body to the upper ends of the elongated holes, the magnet while being retained by the magnet holder is moved as far away from the main body as possible to weaken the magnetic force acting on the main body, thereby making it possible to quickly separate attracted magnetic materials.

[0020] In the arrangement in which the insertion holes are elongated holes, engaging holes may be disposed to extend from the lower ends of the respective insertion holes toward the main body in the adhered state.

[0021] With this arrangement, since it is possible to keep the unlocked state of the magnet holder by temporarily engaging the shaft body in the engaging holes, the pivoting motion of the magnet holder after unlocked is smooth.

[0022] In all of the above arrangements, a bowl-shaped collecting cone may be disposed in the main body so as to collect magnetic materials separating from the inner surface of the main body in the separated state, and the bowl-shaped collecting cone may include a fall facilitating portion of which a downward inclination angle is partially steep, the fall facilitating portion being disposed to correspond to a circumferential position of the collecting cone, to which the magnet is located close in the adhered state.

[0023] With this arrangement, it is possible to hinder magnetic materials from remaining on the upper surface of the collecting cone due to the weakened magnetic force acting on the main body in the separated state.

EFFECTS OF THE INVENTION

[0024] The above arrangements of the present invention facilitate the collection of magnetic materials.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

Fig. 1 is a sectional view of a foreign matter removing device in which a magnetic material collecting mechanism according to a first embodiment of the present invention is used.

Fig. 2 is a perspective view of the foreign matter removing device shown in Fig. 1.

Fig. 3 is a perspective view of a magnet holder of the magnetic material collecting mechanism shown in Fig. 2.

Figs. 4A to 4C are front views showing the operation of the magnetic material collecting mechanism shown in Fig. 2. Fig. 4A shows the state in which the magnet holder is in contact with a main body (adhered state), Fig. 4B shows the state in which the magnet holder is somewhat pivoted, and Fig. 4C shows the state in which the magnet holder is completely separated from the main body (separated state).

Fig. 5 is a perspective view of a foreign matter removing device in which a magnetic material collecting mechanism according to a second embodiment of the present invention is used.

Fig. 6 is a perspective view of a magnet holder of the magnetic material collecting mechanism shown in Fig. 5.

Figs. 7A to 7C are front views showing the operation of the magnetic material collecting mechanism shown in Fig. 5. Fig. 7A shows the state in which the magnet holder is in contact with a main body (adhered state), Fig. 7B shows the state in which the magnet holder is somewhat pivoted, and Fig. 7C shows the state in which the magnet holder is completely separated from the main body (separated state).

Fig. 8 is a perspective view of a foreign matter removing device in which a magnetic material collecting mechanism according to a third embodiment of the present invention is used.

Fig. 9 is a perspective view of a magnet holder of the magnetic material collecting mechanism shown in Fig. 8.

Figs. 10A to 10E are front views showing the operation of the magnetic material collecting mechanism shown in Fig. 8. Fig. 10A shows the state in which the magnet holder is in contact with a main body (adhered state), Fig. 10B shows the state in which the magnet holder is slid upward, Fig. 10C shows the state in which the magnet holder is somewhat pivoted, Fig. 10D shows the state in which the magnet holder is slid toward the front side, and Fig. 10E shows the state in which the magnet holder is completely separated from the main body (separated

state).

Figs. 11A and 11B are sectional views of a foreign matter removing device in which the magnetic material collecting mechanism of the present invention is used. Fig. 11A shows a collecting cone according to a first variation, and Fig. 11B shows a collecting cone according to a second variation.

BEST MODE FOR CARRYING OUT THE INVENTION

[0026] A magnetic material collecting mechanism 1 according to the first embodiment of the present invention is now described with reference to some of the drawings. As shown in Figs. 1 and 2, this magnetic material collecting mechanism 1 can be used in a foreign matter removing device 2 for removing foreign matter (magnetic materials and nonmagnetic materials) in a fluid. This magnetic material collecting mechanism 1 includes, as its main elements, a main body 3 in which a fluid containing foreign matter flows; magnets 4 disposed on the outside of the main body 3; and a magnet holder 6 configured to pivot the magnets 4 about a shaft body 5 provided to the main body 3, between an adhered state in which the magnets 4 are in contact with the outer surface of the main body 3, and a separated state in which the magnets 4 are separated from the outer surface of the main body 3.

[0027] The main body 3 is a main element of the foreign matter removing device 2, and is a hollow cylindrical member made of a resin. The main body 3 of this embodiment is constituted by an upper main body portion 3a and a lower main body portion 3b that are vertically coupled together. An inflow pipe 7 through which a fluid (e.g., hot water) containing foreign matter flows in, and an outflow pipe 8 through which the fluid from which foreign matter has been removed flows out are connected to the upper portion of the main body 3. Also, a deflecting member 9 that deflects downwardly the flow of the fluid flowing in through the inflow pipe 7 is disposed to extend downwardly from the upper end of the main body 3.

[0028] A bowl-shaped collecting cone 10 for collecting foreign matter (both magnetic materials and nonmagnetic materials) from the fluid is disposed near the vertical center of the main body 3. The collecting cone 10 has a circular through hole 11 formed at the center thereof; and a rectangular through hole 12 formed at a position displaced radially (toward the upstream side) from the center of the collecting cone 10. A plurality of vertically extending ribs 13 and 14 are formed on the upper and lower main body portions 3a and 3b, and the height of the collecting cone 10 in the main body 3 is positioned by these ribs 13 and 14. A collecting portion 15 in which collected foreign matter is temporarily stored is disposed under the collecting cone 10. The collecting portion 15 is provided with a cock valve 16; and a plug 17 for closing the downwardly facing opening of the cock valve 16.

[0029] A filter 18 is disposed in a portion of the flow path from the inflow pipe 7 toward the outflow pipe 8. The filter 18 catches foreign objects (both magnetic materials and nonmagnetic materials) of which the sizes are not less than a predetermined value. The lower end of the filter 18 is inserted in the rectangular through hole 12 of the collecting cone 10.

[0030] The magnets 4 are flat plate-shaped substantially cuboid members, and retained by the magnet holder 6 shown in Fig. 3. The magnet holder 6 is composed of a magnetic material, and includes a base portion 20 from which a pair of flanges 19 extend; extended portions 21 extending from the respective flanges 19 in the same direction as the extending direction of the base portion 20; bent portions 22 bent inwardly from the ends of the respective extended portions 21; and retaining pieces 23 bent from the ends of the respective bent portions 22 so as to each extend along one side surface and the top surface of the magnet 4. The flanges 19 are formed, respectively, with insertion holes 24 through which the shaft body 5, which is provided horizontally to the main body 3, is inserted. The magnets 4 are each attracted to a plurality of surfaces of the bent portion 22 and the retaining piece 23 by its own magnetic force. The term "horizontally" used herein relative to the shaft body 5 refers to not only exactly horizontal direction but also slight inclination that does not hinder the pivoting motion of the magnet holder 6 (for example, a maximum of about 5 degrees).

[0031] The portions of the shaft body 5 inserted through the insertion holes 24 have a D-shaped cross section. The insertion holes 24 have a D shape corresponding to the sectional shape of the shaft body 5. The shaft body 5 is provided with a handle 25 for conducting pivotal motion. Instead of conducting pivotal motion with the handle 25, pivotal motion may be conducted with the base portion 20 of the magnet holder 6.

[0032] Planar recesses 26 are formed in the outer surface of the main body 3 such that in the adhered state, the magnets 4 are in contact with the respective recesses 26, specifically, the surfaces of the magnets 4 are in contact with the surfaces of the respective recesses 26. The upper edge of each recess 26 comprises a stepped portion 27 that applies pivoting resistance to the magnet holder 6 by coming into contact with the magnet 4 or the magnet holder 6 during upward pivoting motion of the magnet holder 6.

[0033] Tables 28 having a flat plate-shaped top surface are disposed on the outer surface of the main body 3 so as to extend radially outwardly. The tables 28 are fixed to the main body 3 by fasteners as magnetic members 29 (the same reference number as used with respect to the magnetic members is hereinafter used with respect to the fasteners). In the adhered state, the magnet holder 6 and the magnets 4 are on the top surfaces of the tables 28, and attracting forces are acting between the magnets 4 and the respective fasteners 29. In this embodiment, screws are used as the fasteners 29, but spring pins may be used instead.

[0034] The operation of the foreign matter removing device 2 provided with the magnetic material collecting

mechanism 1 of the first embodiment is now described. In a normal use state of this foreign matter removing device 2, the magnetic material collecting mechanism 1 is in the adhered state shown in Fig. 4A. A fluid containing foreign matter (magnetic materials and nonmagnetic materials) that has flowed into the main body 3 through the inflow pipe 7 is deflected downward by the deflecting member 9, and passes through the filter 18, which is disposed in the main body 3. At this time, foreign objects (both magnetic materials and nonmagnetic materials) of which the sizes are not less than a predetermined value are caught by the filter 18. The caught foreign objects are carried by the fluid flowing downward along the surface of the filter 18 without remaining on the surface of the filter 18, and fall into the collecting portion 15 through the rectangular through hole 12 of the collecting cone 10.

[0035] On the other hand, the fluid containing small-sized foreign objects that has passed through the filter 18 is deflected upward in the vicinity of the collecting cone 10. At this time, foreign objects which are larger in specific gravity than the fluid flow near the inner surface of the main body 3, and the magnetic materials in the foreign objects are attracted to the inner surface of the main body 3 by the attracting forces of the magnets 4, which are disposed in the magnetic material collecting mechanism 1. The fluid from which the magnetic materials have been removed flows out of the main body 3 through the outflow pipe 8.

[0036] When conducting the maintenance of the foreign matter removing device 2, after temporarily stopping the fluid flow, the state of the magnetic material collecting mechanism 1 is switched from the adhered state (see Fig. 4A) to the separated state (see Fig. 4C). In a normal use state of the foreign matter removing device 2, the magnetic material collecting mechanism 1 is in the adhered state shown in Fig. 4A, in which the magnets 4 and the magnet holder 6 are supported by the tables 28. At this time, attracting forces act between the magnets 4 and the respective fasteners 29, and a user can get a click feeling due to the attraction.

[0037] When the handle 25, which is provided on the shaft body 5, is pulled down toward the front/outflow side against the attracting forces between the magnets 4 and the fasteners 29, and the pivoting resistance applied by the stepped portions 27, as shown in Fig. 4B, the magnets 4 or the magnet holder 6 and the stepped portions 27 are brought out of contact with each other, and the magnet holder 6 begins to pivot upward about the shaft body 5. As shown in Fig. 4C, by further pivoting the magnet holder 6 to a position where a portion of the magnet holder 6 (portion near the base portion 20 in this embodiment) abuts against the main body 3 and stops stably, the state of the magnets 4 becomes the separated state in which the magnets 4 are sufficiently separated from the outer surface of the main body 3. When the state of the magnets 4 becomes the separated state, since this weakens the attracting forces of the magnets 4 attracting magnetic materials to the inner surface of the main body 3, the magnetic materials separate from the above inner surface, and fall into the collecting portion 15 through the circular through hole 11, which is formed in the center of the collecting cone 10 (see Fig. 1).

[0038] By removing the plug 17, which is provided on the cock valve 16, and opening the cock valve 16, the foreign matter (magnetic materials and nonmagnetic materials) that has fallen into the collecting portion 15 is discharged together with the fluid to the outside of the foreign matter removing device 2.

[0039] Since, in the magnetic material collecting mechanism 1 of the first embodiment, by simply pivoting the magnet holder 6 about the shaft body 5, which is provided horizontally to the main body 3, it is possible to switch one to the other of the adhered state and the separated state of the magnets 4, there is no risk of losing parts, and magnetic materials can be collected easily. Also, since the pivoting mechanism of the magnet holder 6 has a simple structure, there is a cost advantage.

[0040] Also, since, for the magnetic material collecting mechanism 1 of the first embodiment, attracting forces act between the magnets 4 and the fasteners 29, and pivoting resistance is applied to the magnet holder 6 by forming the stepped portions 27 at the upper edges of the recesses 26, and conducting temporary fixing, it is possible to prevent the situation in which the adhered state is released (the magnets are separated) in an unexpected manner. Also, when the magnet holder 6 (as well as the magnets 4) is on the tables 28 (adhered state), the magnet holder 6 is in a stable state. Therefore, even if the magnet holder 6 separates upward from the tables 28 due to the vibration applied, e.g., during transportation, the magnet holder 6 can return to this stable state quickly.

[0041] Also, in the magnetic material collecting mechanism 1 of the first embodiment, since each magnet 4 is firmly adhered to a plurality of surfaces of the bent portion 22 and the retaining piece 23 of the magnet holder 6, when the adhered state is switched to the separated state, it is possible to prevent displacement of the magnets 4 from predetermined positions in the magnet holder 6 due to the attracting forces between the magnets 4 and the magnetic materials attracted to the inner surface of the main body 3.

[0042] Also, in the magnetic material collecting mechanism 1 of the first embodiment, since the portions of the shaft body 5 inserted through the insertion holes 24 have a D-shaped cross-section, and the insertion holes 24 have a D shape corresponding to the sectional shape of the shaft body 5, pivoting motion can be reliably transmitted between the shaft body 5 and the magnet holder 6.

[0043] Fig. 5 shows a foreign matter removing device 2 in which a magnetic material collecting mechanism 1 according to the second embodiment of the present invention is used. The magnetic material collecting mechanism 1 of the second embodiment has the same basic structure as that of the first embodiment, but is different therefrom in the shape of e.g., the magnetic holder 6 and

the pivoting direction of the magnet holder 6.

[0044] As shown in Fig. 6, the magnet holder 6 of the second embodiment includes a base portion 20 from which a pair of flanges 19 extend; extended portions 21 extending at a bend angle of 45 degrees from both sides of the base portion 20; bent portions 22 bent further somewhat inwardly from the ends of the respective extended portions 21; and retaining pieces 23 each bent from the end of the bent portion 22 so as to extend along one side surface and the top surface of the magnet 4. The flanges 19 are formed, respectively, with insertion holes 24 through which the shaft body 5, which is provided horizontally to the main body 3, is inserted.

[0045] The portions of the shaft body 5 inserted through the insertion holes 24 have a D-shaped cross section. The insertion holes 24 have a D shape corresponding to the sectional shape of the shaft body 5. The shaft body 5 is provided with a handle 25 for conducting pivotal motion. Planar recesses 26 are formed in the outer surface of the main body 3 such that in the adhered state, the magnets 4 are in contact with the respective recesses 26, specifically, the surfaces of the magnets 4 are in contact with the surfaces of the respective recesses 26. The main body 3 is formed with a resistance portion 30 (snap-fit portion) that applies pivoting resistance to the magnet holder 6 by abutting against the outer surface of the base portion 20 at its lower end portion in the adhered state.

[0046] When conducting the maintenance of the foreign matter removing device 2, after temporarily stopping the fluid flow, the state of the magnetic material collecting mechanism 1 is switched from the adhered state (see Fig. 7A) to the separated state (see Fig. Fig. 7C). In the adhered state shown in Fig. 7A, the outer surface of the base portion 20 (of the magnet holder 6) at its lower end portion is in abutment with the resistance portion 30 on the side surface of the main body 3 such that pivoting resistance is applied to the magnet holder 6.

[0047] When the handle 25, which is provided on the shaft body 5, is pulled up toward the front/outflow side, and the magnet holder 6 is pivoted against the pivoting resistance applied by the resistance portion 30, as shown in Fig. 7B, the abutment between the magnet holder 6 and the resistance portion 30 is released, and the magnet holder 6 begins to pivot about the shaft body 5. As shown in Fig. 7C, by further pivoting the magnet holder 6 until a portion of the magnet holder 6 (portion near the base portion 20 in this embodiment) abuts against the main body 3, the state of the magnets 4 becomes the separated state in which the magnets 4 are sufficiently separated from the outer surface of the main body 3. When the state of the magnets 4 becomes the separated state, since this weakens the attracting forces of the magnets 4 attracting magnetic materials to the inner surface of the main body 3, the magnetic materials separate from the above inner surface, and fall into the collecting portion 15 through the circular through hole 11, which is formed in the center of the collecting cone 10 (see Fig. 1).

[0048] In the magnetic material collecting mechanism 1 of the second embodiment, since as in the magnetic material collecting mechanism 1 of the first embodiment, by simply pivoting the magnet holder 6 about the shaft body 5, which is provided horizontally to the main body 3, it is possible to switch one to the other of the adhered state and the separated state of the magnets 4, there is no risk of losing parts, and magnetic materials can be collected easily. Also, since the pivoting mechanism of the magnet holder 6 has a simple structure, there is a cost advantage.

[0049] Also, since, in the magnetic material collecting mechanism of the second embodiment, the resistance portion 30 is formed on the side surface of the main body 3 so as to apply pivoting resistance to the magnet holder 6, a user can get a click feeling when pivoting the magnet holder, and can easily sense switching between the adhered state and the separated state. Also, it is possible to prevent the situation in which the adhered state is released (the magnets are separated) in an unexpected manner.

[0050] Also, in the magnetic material collecting mechanism 1 of the second embodiment, since the portions of the shaft body 5 inserted through the insertion holes 24 have a D-shaped cross-section, and the insertion holes 24 have a D shape corresponding to the sectional shape of the shaft body 5, pivoting motion can be reliably transmitted between the shaft body 5 and the magnet holder 6.

[0051] Also, in the magnetic material collecting mechanism 1 of the second embodiment, since the top surfaces of the magnets 4 are adhered to the respective retaining pieces 23, when switching the adhered state to the separated state, it is possible to prevent the magnets 4 from separating from the magnet holder 6, and remaining at the position of the adhered state due to the attracting forces between the magnets 4 and the magnetic materials attracted to the inner wall of the main body 3.

[0052] Also, since the retaining pieces 23 are each formed to extend along the top surface, of the magnet 4 from the end of the bent portion 22 of the magnet holder 6, the retaining pieces 23 are located between the main body 3 and the respective magnets 4 in the separated state, and the attracting forces of the magnets 4 are shielded by the retaining pieces 23. This further weakens the attracting forces of the magnets 4 attracting magnetic materials to the inner surface of the main body 3, thus making it possible to separate the magnetic materials more smoothly.

[0053] Fig. 8 shows a foreign matter removing device 2 in which a magnetic material collecting mechanism 1 according to the third embodiment of the present invention is used. The magnetic material collecting mechanism 1 of the third embodiment has the same basic structure as that of, e.g., the first embodiment, but is different therefrom in the shape of, e.g., the magnet holder 6.

[0054] As shown in Fig, 9, the magnet holder 6 of the third embodiment includes a base portion 20 from which a pair of flanges 19 extend; extended portions 21 extend-

ing at a bend angle of 45 degrees from both sides of the base portion 20; and retaining pieces 23 each bent from the end of the extended portion 21 so as to extend along the top surface and one side surface of the magnet 4. The flanges 19 are formed, respectively, with insertion holes 24 through which the shaft body 5, which is provided horizontally to the main body 3, is inserted. The insertion holes 24 are elongated holes elongated in the vertical direction when the magnets 4, which are retained by the magnet holder 6, are in the adhered state. Engaging holes 31 are formed to extend from the lower ends of the respective insertion holes 24 toward the main body 3 in the adhered state.

[0055] The shaft body 5, which is inserted through the through holes 24 of the magnet holder 6, is provided horizontally to the side surface of the main body 3. The outer surface of the main body 3 is formed with an abutment portion 32 that blocks the pivoting motion of the magnet holder 6 by abutting against the outer surface of the base portion 20 (of the magnet holder 6) at its lower end portion in the adhered state. A slit into which the base portion 20 of the magnet holder 6 is insertable is formed between the abutment portion 32 and the outer surface of the main body 3. Also, planar recesses 26 are formed in the outer surface of the main body 3 such that in the adhered state, the magnets 4 are in contact with the respective recesses 26, specifically, the surfaces of the magnets 4 are in contact with the surfaces of the respective recesses 26.

[0056] When conducting the maintenance of the foreign matter removing device 2, after temporarily stopping the fluid flow, the state of the magnetic material collecting mechanism 1 is switched from the adhered state (see Fig. 10A) to the separated state (see Fig. Fig. 10E). In the adhered state shown in Fig. 10A, the outer surface of the base portion 20 (of the magnet holder 6) at its lower end portion is in abutment with the abutment portion 32 on the side surface of the main body 3, and the pivoting motion of the magnet holder 6 is blocked. At this time, the shaft body 5 is located at the vertical central portions of the insertion holes 24.

[0057] As shown in Fig. 10B, by sliding the magnet holder 6 upward, the abutment between the abutment portion 32 and the magnet holder 6 is released. At this time, the shaft body 5 is located in the engaging holes 31, which extend from the lower ends of the respective insertion holes 24. Further, as shown in Fig. 10C, with the shaft body 5 located in the engaging holes 31, the magnet holder 6 is pivoted about the shaft body 5. After the magnet holder 6 is pivoted to some extent, as shown in Fig. 10D, the magnet holder 6 is slid obliquely downward not to come into contact with the outflow pipe 8. At this time, the shaft body 5 moves to the upper ends of the through holes 24.

[0058] Further, as shown in Fig. 10E, with the shaft body 5 located at the upper ends of the insertion holes 24, the magnet holder 6 is further pivoted until the state of the magnets 4 becomes the separated state in which the magnets 4 are sufficiently separated from the outer surface of the main body 3. When the state of the magnets 4 becomes the separated state, since this weakens the attracting forces of the magnets 4 attracting magnetic materials to the inner surface of the main body 3, the magnetic materials separate from the above inner surface, and fall into the collecting portion 15 through the circular through hole 11, which is formed in the center of the collecting cone 10. The spacing distance between each magnet 4 and the main body 3 spaced apart from each other in the separated state can be further increased by increasing the lengths of the insertion holes 24. By increasing the spacing distance, it is possible to further weaken the attracting forces of the magnets 4 attracting magnetic materials to the inner surface of the main body 3 when the magnets are in the separated state, and thus separate the magnetic materials more smoothly.

[0059] In the magnetic material collecting mechanism 1 of the third embodiment, since, by simply pivoting the magnet holder 6 about the shaft body 5, which is provided horizontally to the main body 3, it is possible to switch one to the other of the adhered state and the separated state of the magnets 4, there is no risk of losing parts, and magnetic materials can be collected easily. Also, since the pivoting mechanism of the magnet holder 6 has a simple structure, there is a cost advantage.

[0060] Also, in the magnetic material collecting mechanism 1 of the third embodiment, since engaging holes 31 extending from the respective insertion holes 24 are formed such that the shaft body 5 is engageable in the engaging holes 31, when the abutment between the abutment portion 32 and the magnet holder 6 is released by sliding the magnet holder 6 upward, the released state is maintained. Therefore, it is possible to smoothly pivot the magnet holder 6 subsequently.

[0061] Also, in the magnetic material collecting mechanism 1 of the third embodiment, since retaining pieces 23 are formed which are each bent from the end of the extended portion 21 of the magnet holder 6 so as to extend along the top surface of the magnet 4, the retaining pieces 23 are located between the main body 3 and the respective magnets 4 in the separated state, and the attracting forces of the magnets 4 are shielded by the retaining pieces 23. This further weakens the attracting forces of the magnets 4 attracting magnetic materials to the inner surface of the main body 3, thus making it possible to separate the magnetic materials more smoothly. Arrangement of the retaining pieces 23 may be changed as necessary.

[0062] In the foreign matter removing device 2 of each of the above embodiments, the inclination angle of the upper surface of the collecting cone 10 is constant irrespective of the position of its inner surface, but, as shown in Fig. 11A, a fall facilitating portion 33 having a downward steep inclination angle may be formed at the upper end portion of the collecting cone 10, against which the magnetic materials separated when the magnets are in the separated state directly abut. Also, as shown in Fig. 11B, a fall facilitating portion 33 may be formed by displacing

the circular through hole 11 of the collecting cone 10 toward the magnet holder 6 (toward the magnets 4) such that the inclination angle on the side of the magnet holder 6 (on the side of the magnets 4) is steep.

[0063] By forming such a fall facilitating portion 33, when the magnets are in the separated state, it is possible to prevent the magnetic materials separating from the inner surface of the main body 3 from remaining near the upper end of the upper surface of the collecting cone 10 due to the weakened attracting forces of the magnets 4, thus improving the collecting efficiency of such magnetic materials.

[0064] The above-described embodiments are mere examples in every respect, and the present invention is not limited thereto. Therefore, the scope of the present invention is indicated not by the above description but by the claims, and should be understood to include all modifications and the meaning equivalent to the scope of the claims.

[0065] In the above magnetic material collecting mechanisms 1, the magnet holder 6 is pivoted about a shaft body 5 horizontally provided to the main body 3, but, for example, the magnet holder 6 may be pivoted about a shaft body 5 vertically provided to the main body 3. Also, in each of the above embodiments, the foreign matter removing device 2 may be a maintenancefree device which does not require work by a person, specifically, in which after temporarily stopping the fluid flow automatically with, e.g., a timer, the magnet holder 6 is pivoted by a motor.

DESCRIPTION OF REFERENCE NUMERALS

[0066]

1. Magnetic material collecting mechanism
2. Foreign matter removing device
3. Main body
3a. Upper main body portion
3b. Lower main body portion
4. Magnet
5. Shaft body
6. Magnet holder
7. Inflow pipe
8. Outflow pipe
9. Deflecting member
10. Collecting cone
11. (Circular) through hole
12. (Rectangular) through hole
13, 14. Rib
15. Collecting portion
16. Cock valve
17. Plug
18. Filter
19. Flange
20. Base portion
21. Extended portion
22. Bent portion
23. Retaining piece
24. Insertion hole
25. Handle
26. Recess
27. Stepped portion
28. Table
29. Magnetic member (fastener)
30. Resistance portion
31. Engaging hole
32. Abutment portion
33. Fall facilitating portion

Claims

1. A magnetic material collecting mechanism comprising:

a main body (3) to which a shaft body (5) is provided, and in which a fluid containing magnetic materials flows;
a magnet (4) disposed on an outside of the main body (3); and
a magnet holder (6) configured to pivot the magnet (4) about the shaft body (5), between an adhered state in which the magnet (4) is in contact with an outer surface of the main body (3), and a separated state in which the magnet (4) is separated from the outer surface of the main body (3),
wherein the magnetic material collecting mechanism is configured such that magnetic materials attracted to an inner surface of the main body (3) when the magnet (4) is in the adhered state are separated from the inner surface of the main body (3) by switching the adhered state of the magnet (4) to the separated state, and the separated magnetic materials are collected.

2. The magnetic material collecting mechanism according to claim 1, wherein the shaft body (5) is provided horizontally,

wherein the magnet holder (6) has insertion holes (24) through which the shaft body (5) is inserted, and
wherein the magnet holder (6) is configured to pivot between the adhered state and the separated state.

3. The magnetic material collecting mechanism according to claim 1 or 2, wherein the main body (3) has, in the outer surface of the main body (3), a recess (26) with which the magnet (4) is in contact in the adhered state, and
wherein the recess (26) has an edge comprising a stepped portion (27) configured such that the magnet (4) or the magnet holder (6) comes into contact with

the stepped portion (27) when the magnet holder (6) pivots.

4. The magnetic material collecting mechanism according to any one of claims 1 to 3, wherein a resistance portion (30) is formed on a side surface of the main body (3), the resistance portion (30) being configured to abut against the magnet holder (6) in the adhered state, thereby applying pivoting resistance to the magnet holder (6).

5. The magnetic material collecting mechanism according to any one of claims 1 to 4, wherein the main body (3) is provided with a magnetic member (29) configured to be attracted to the magnet (4) in the adhered state, and apply pivoting resistance to the magnet holder (6).

6. The magnetic material collecting mechanism according to claim 2, wherein the main body (3) is formed with an abutment portion (32) configured to abut against an outer surface of a lower end portion of the magnet holder (6) in the adhered state, thereby blocking pivoting motion of the magnet holder (6),

wherein the insertion holes (24) are elongated holes elongated in a vertical direction when the magnet holder (6) is in the adhered state, and
wherein the magnetic material collecting mechanism is configured such that the shaft body (5) is located at vertical central portions of the insertion holes (24) in the adhered state;
the shaft body (5) is located at lower ends of the insertion holes (24) in a state in which abutment between the abutment portion (32) and the magnet holder (6) is released by sliding the magnet holder (6) upward; and
the shaft body (5) is located at upper ends of the insertion holes (24) in the separated state of the magnet (4).

7. The magnetic material collecting mechanism according to claim 6, wherein engaging holes (31) are disposed to extend from the lower ends of the respective insertion holes (24) toward the main body (3) in the adhered state.

8. The magnetic material collecting mechanism according to any one of claims 1 to 7, wherein a bowl-shaped collecting cone (10) is disposed in the main body (3) so as to collect magnetic materials separating from the inner surface of the main body (3) in the separated state, and
wherein the bowl-shaped collecting cone (10) includes a fall facilitating portion (33) of which a downward inclination angle is partially steep, the fall facilitating portion (33) being disposed to correspond to a circumferential position of the collecting cone (10) to which the magnet (4) is located close in the adhered state.

FIG. 1

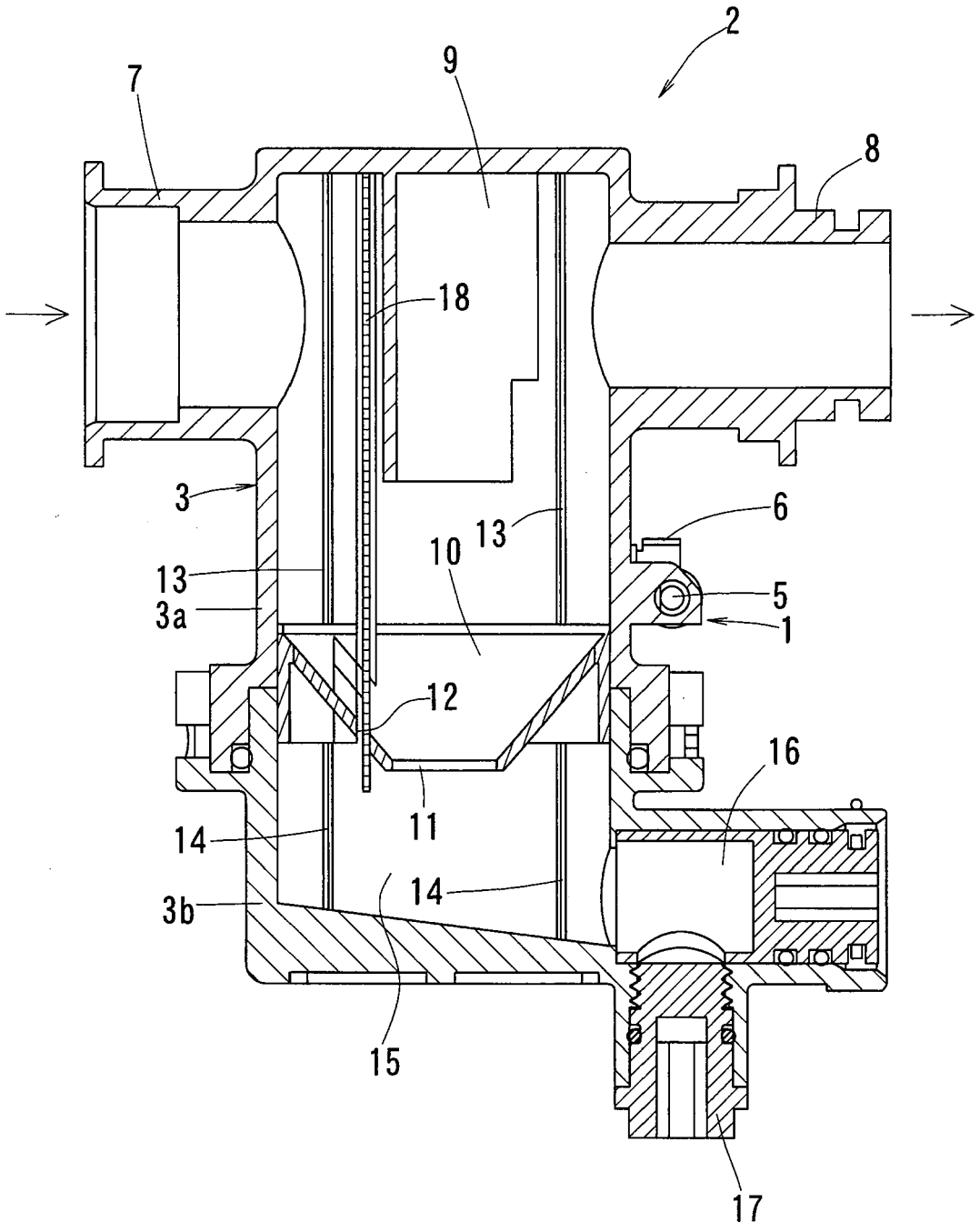


FIG. 2

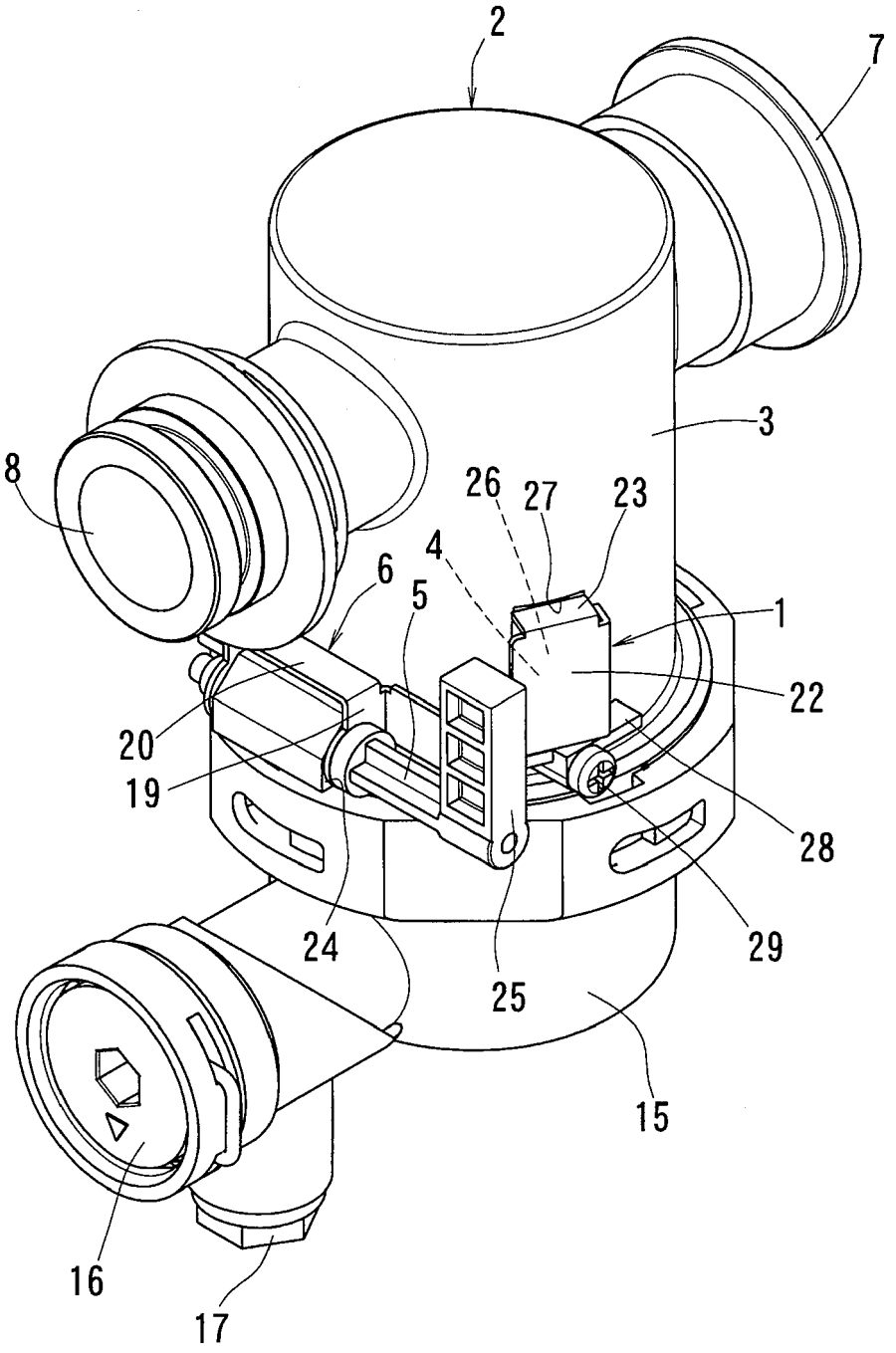


FIG. 3

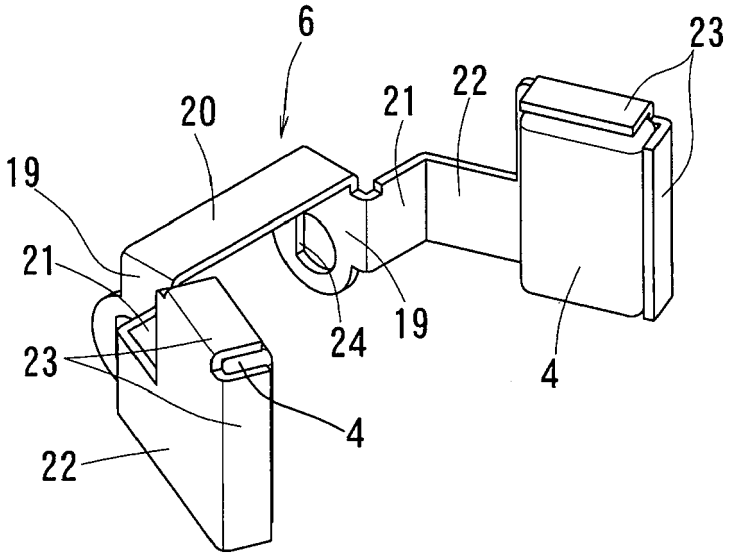


FIG. 4A

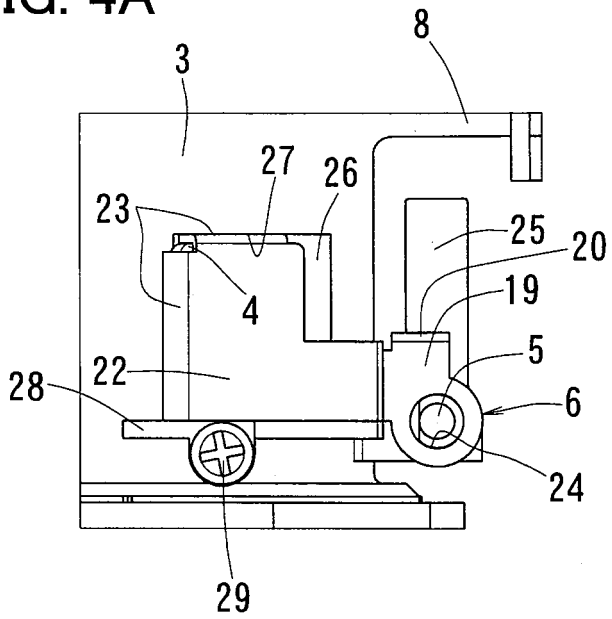


FIG. 4B

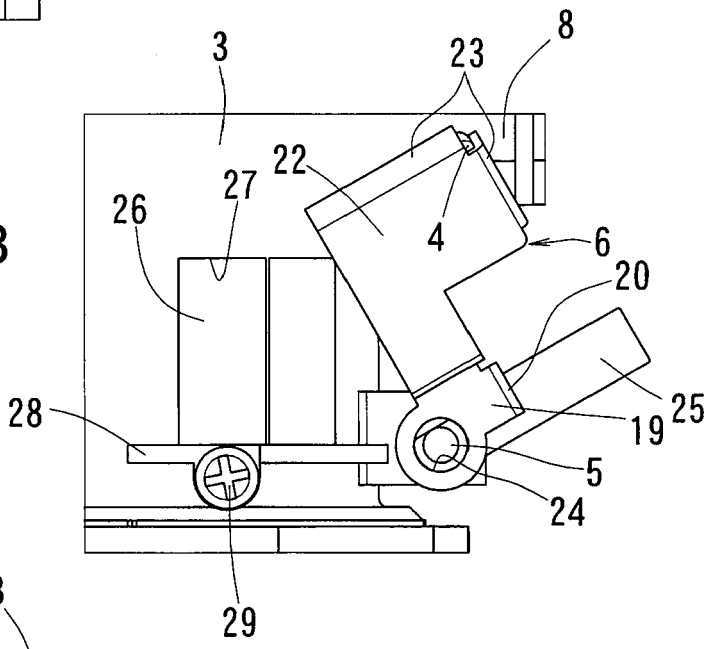


FIG. 4C

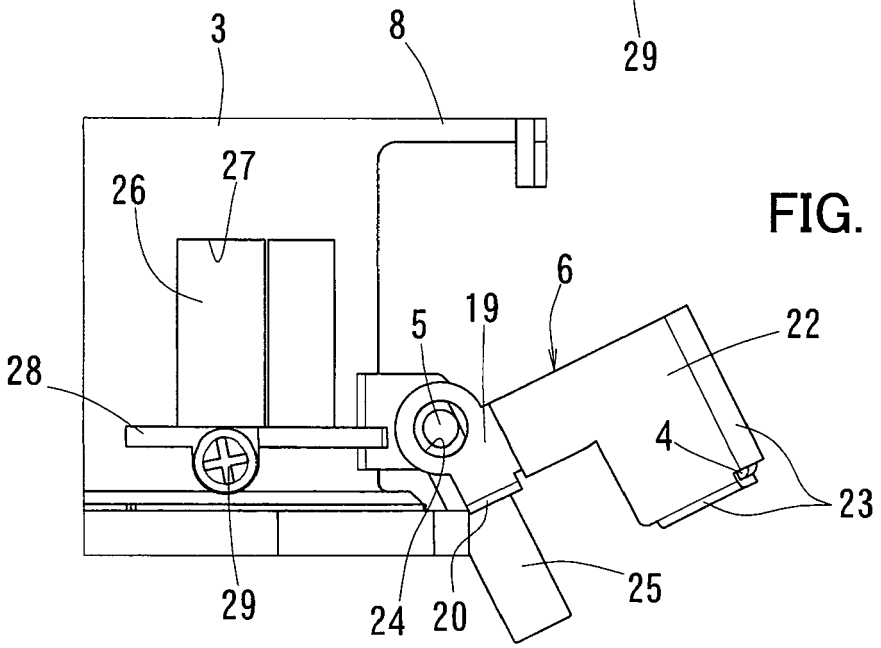


FIG. 5

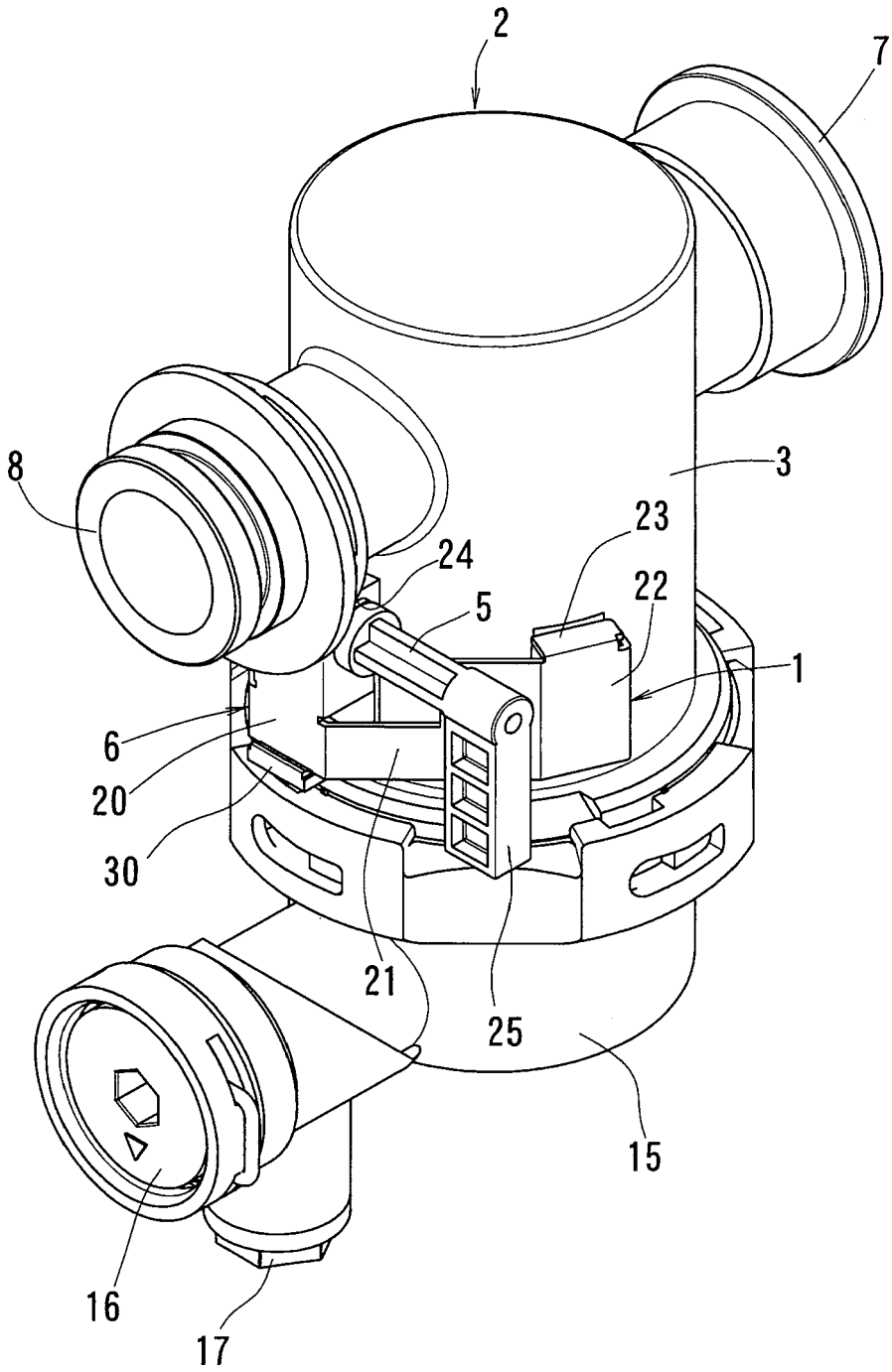


FIG. 6

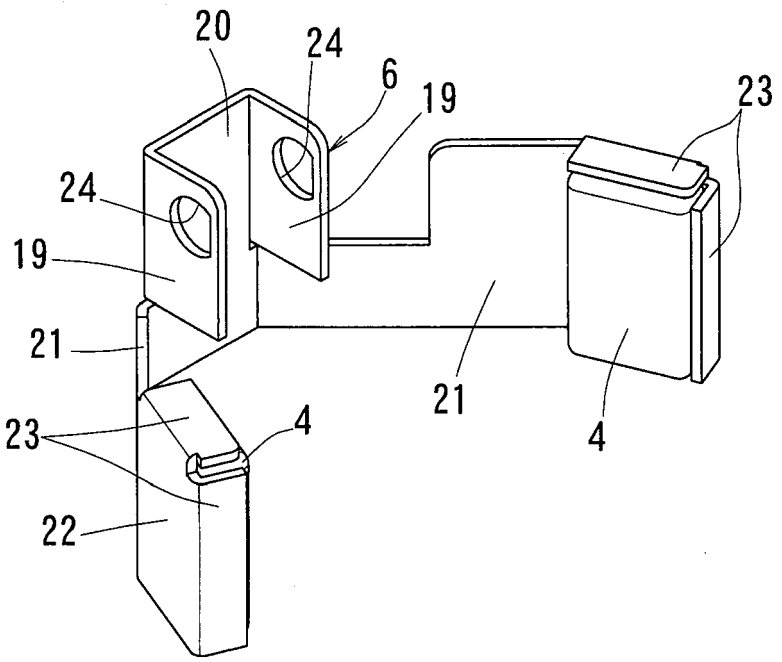


FIG. 7A

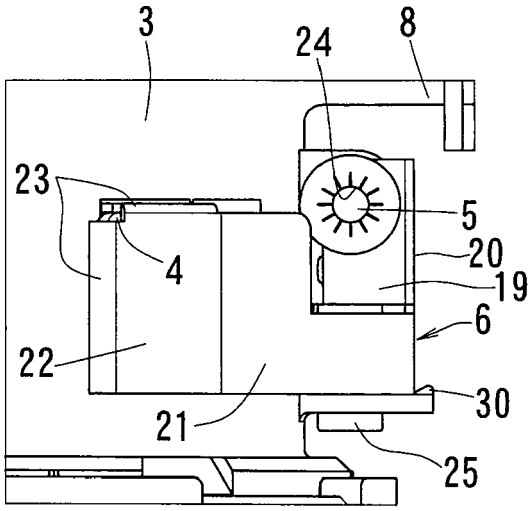


FIG. 7B

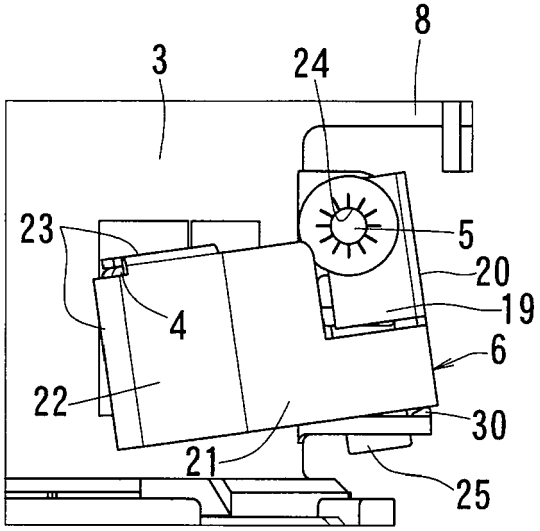


FIG. 7C

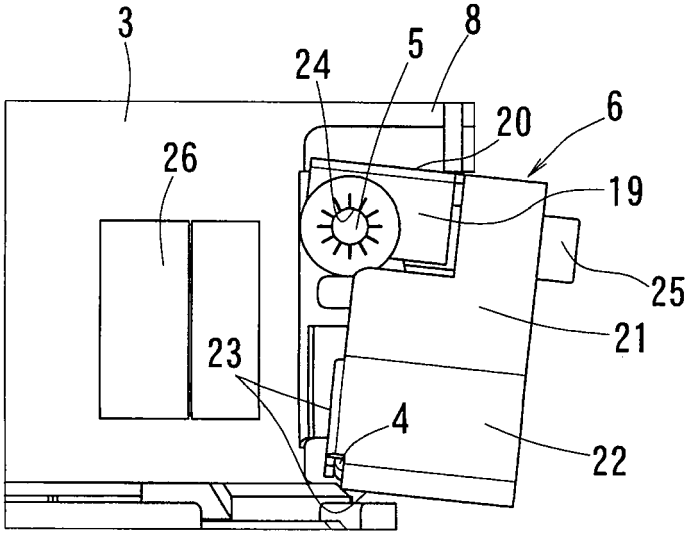


FIG. 8

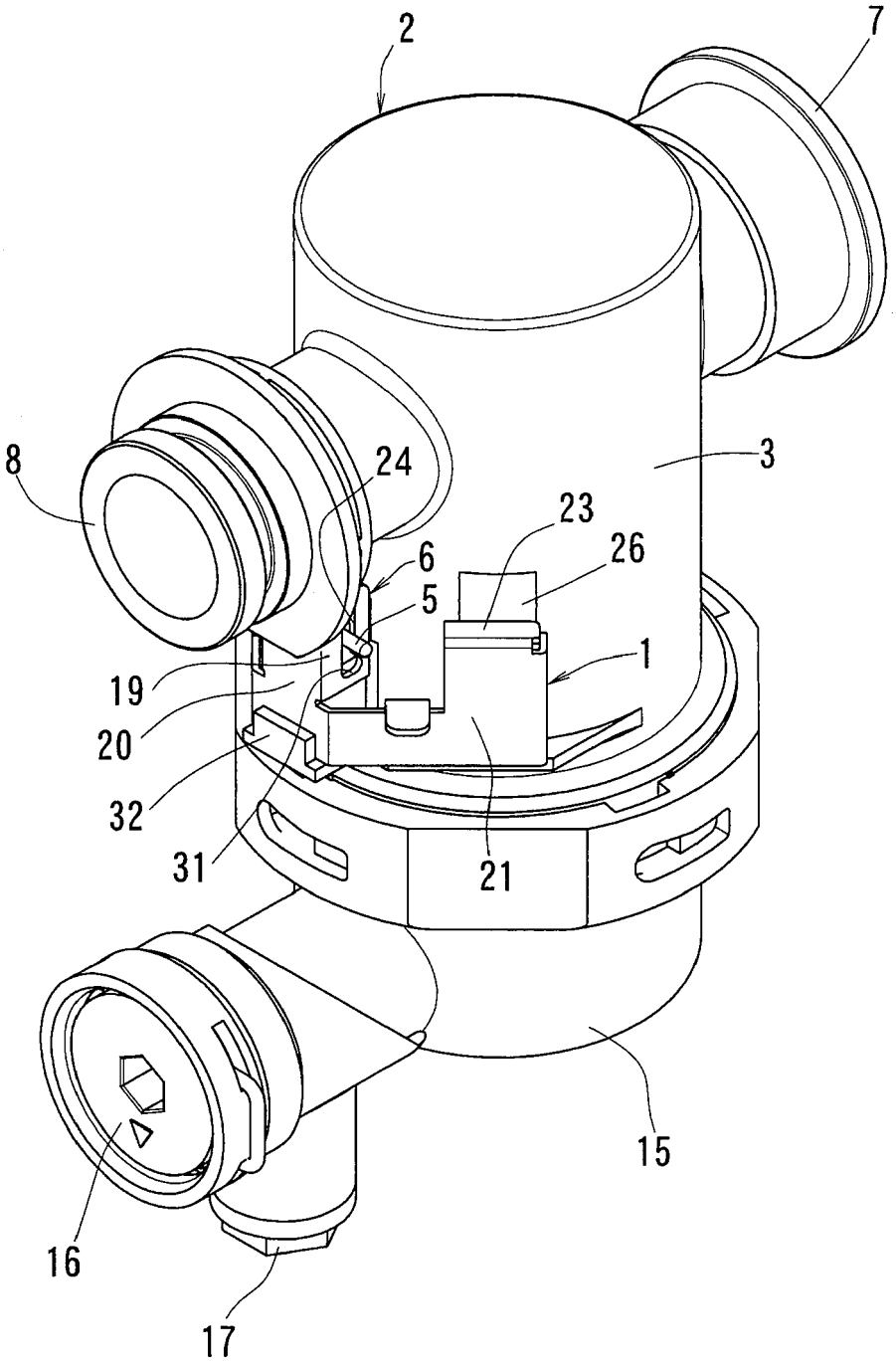


FIG. 9

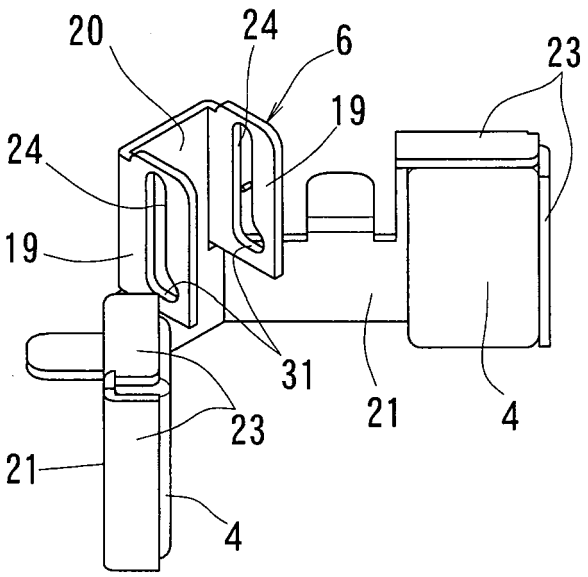


FIG. 10A

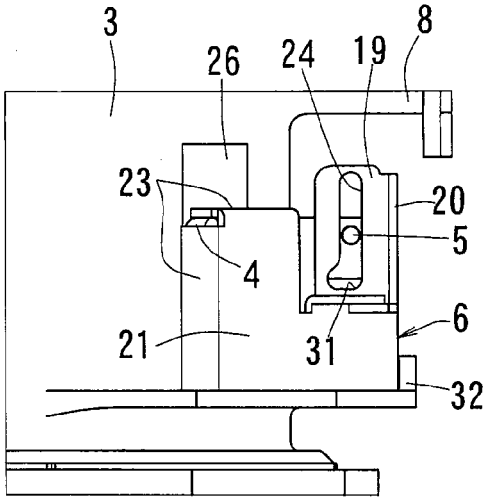


FIG. 10B

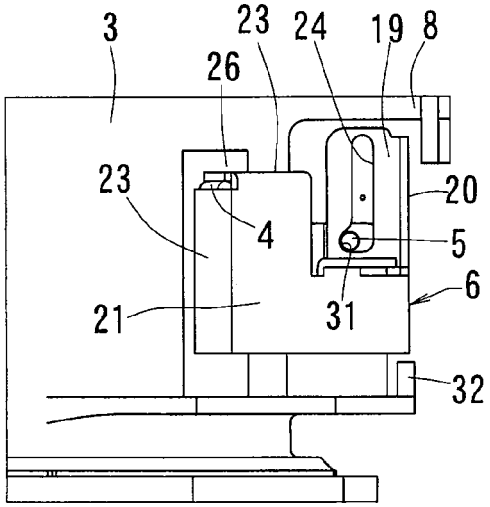


FIG. 10C

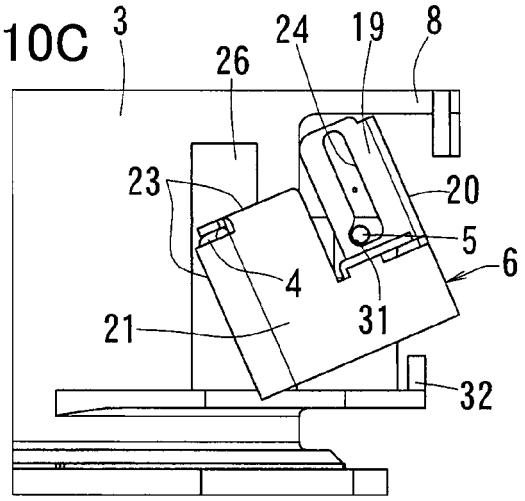


FIG. 10D

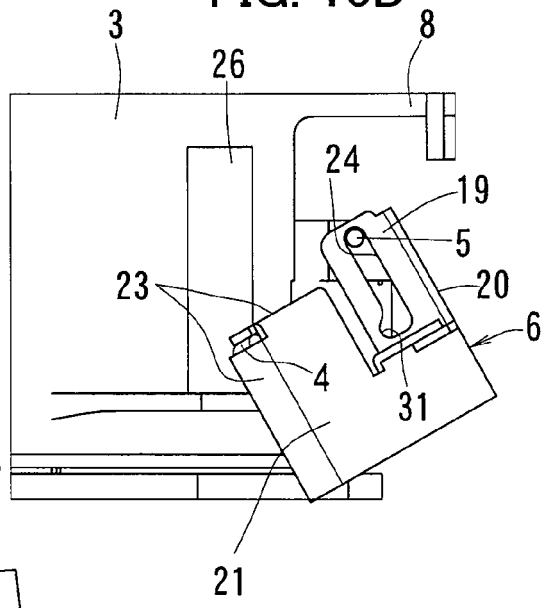


FIG. 10E

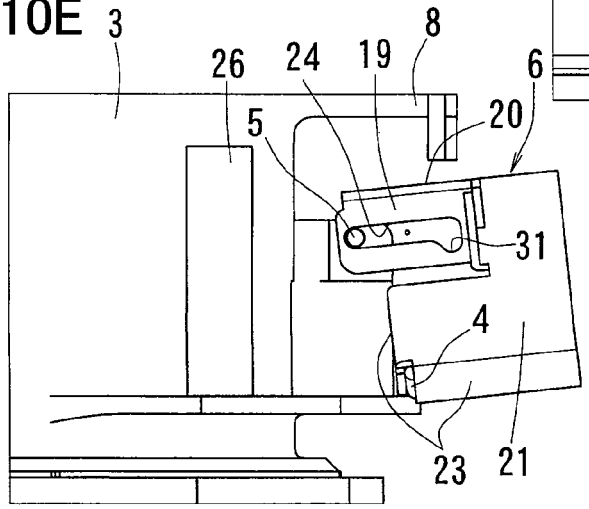


FIG. 11A

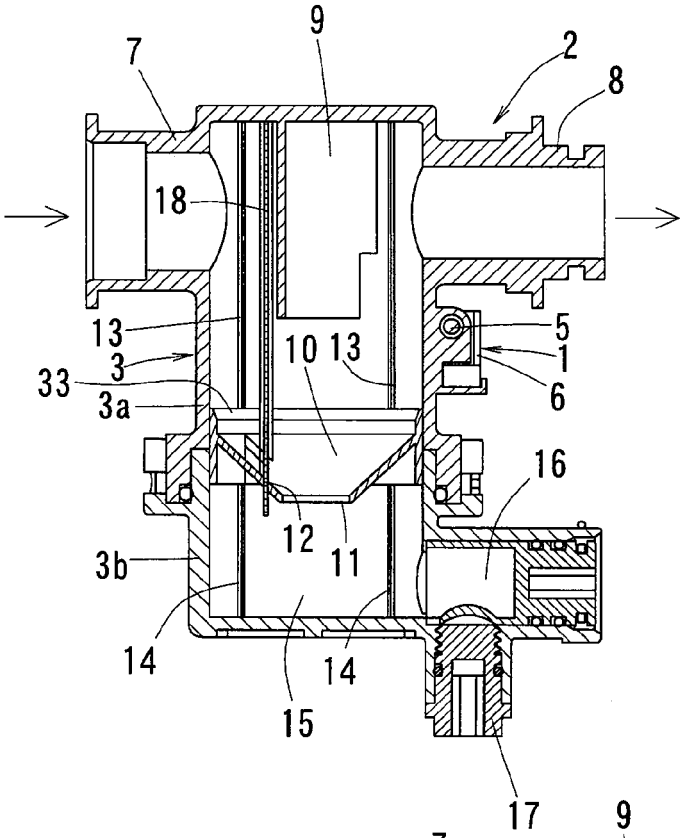
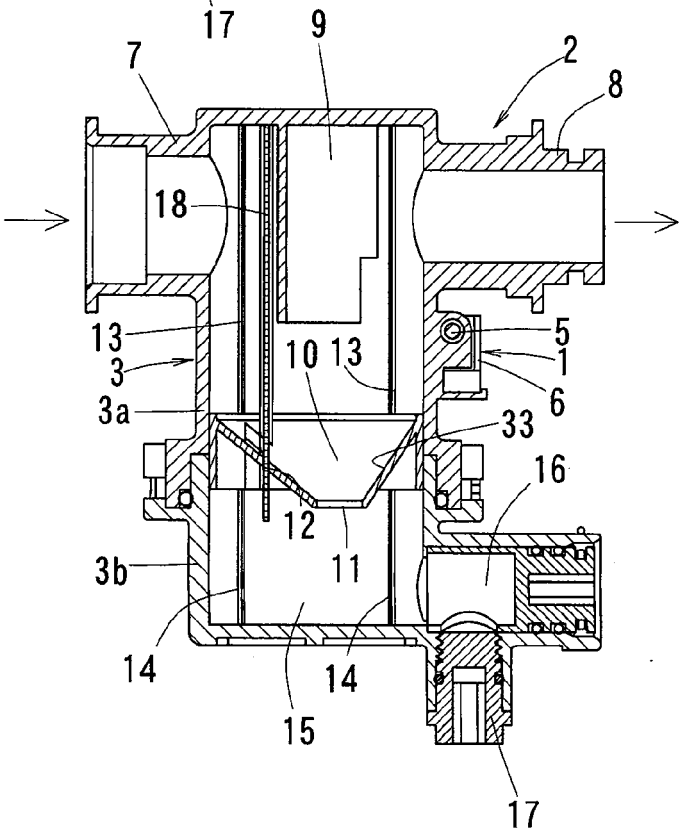


FIG. 11B



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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 0305

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X	US 2021/046487 A1 (DOWNIE SIMON [GB] ET AL) 18 February 2021 (2021-02-18)	1,2,4,5	INV. B03C1/033
Y	* paragraph [0044] - paragraph [0066];	8	B03C1/28
A	figures 1-6 *	3,6,7	
X	US 2001/013491 A1 (KASKE EGON [DE]) 16 August 2001 (2001-08-16)	1,2,4,5	
Y	* paragraph [0059] - paragraph [0122];	8	
A	figures 1-7 *	3,6,7	
Y	JP 2022 103686 A (YJS KK) 8 July 2022 (2022-07-08)	8	
A	* the whole document *	1-7	

TECHNICAL FIELDS SEARCHED (IPC)

B03C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 April 2024	Skaropoulos, N

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30-04-2024

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