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(54) Device for holding cartridges for an ink-jet printer and keeping them supplied with ink.

(57) A device for holding cartridges (32) from an ink-jet printer and keeping them supplied with ink comprises a container (10) divided into two chambers. The lower chamber (20) is filled with ink and the upper chamber (22) contains a seat (29,30) for housing one or more used cartridges (32). The cartridges are automatically supplied with new ink drawn from the lower chamber by means of porous elements (26) having a capillary structure, which are immersed in the ink and communicate with the cartridges by means of a hole (54) in one (33) of their walls.

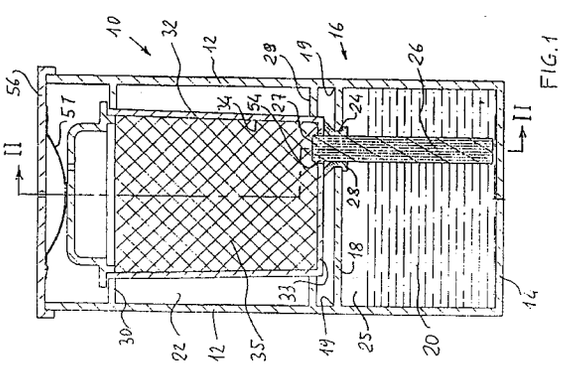

FIG.1

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Background of the Invention

This invention relates to a device for holding printer cartridges, especially cartridges for an ink-jet printer, and keeping them supplied with ink.

One very important requirement when using ink-jet printers is always having a printing head ready for use, i.e. always supplied with ink.

Ink-jet printers normally use a printing device which can be of two types. The first type is formed by a printing head integral with the ink reservoir. In the second type, the head is separate from the reservoir and is fixed to a support integral with the carriage and is supplied with ink by means of a cartridge to be inserted into the head support. In this latter case, the cartridge is automatically connected to the head so that it can be supplied with ink by means of various hydraulic connecting devices, as described, e.g. United States Patents in US-A-5 119 115 and US-A-3 967 286. In particular, US-A-3 967 286 relates to a type of hydraulic connection using a capillary element to supply the reservoir of a printing head.

Each time a used cartridge of an ink-jet printing head is replaced by a new cartridge full of ink, the operator has two possible courses of action. The first is to throw away the used cartridge. The second possibility is to refill the used cartridge with more ink by one of the known methods, including, e.g. using a syringe to inject an appropriate quantity of ink into the reservoir, as described in United States Patent US-A-4 419 677.

The first solution is quite inadvisable as it represents a costly waste of material and above all contributes to pollution of the environment by non-biodegradable materials, such as the resins generally used in the manufacture of cartridges of this kind.

However the second solution is not very appealing to the operators of ink-jet printers as it involves wasting time and the risk of dirtying the hands and of dirtying the console or the surrounding objects.

Summary of the Invention

Therefore, an object of this invention is to provide a device for keeping printer cartridges supplied with ink and in which they can be kept for a considerable period of time so as to eliminate the abovementioned disadvantages.

Another important object of this invention is to provide a device which is separate from the printer and is adapted to supply one or more used cartridges with new ink, and/or to keep one or more cartridges full of ink intact and ready for use for an indefinite period of time.

The present invention is defined in the independent claims below to which reference should now be made. Advantageous features of the invention are set forth in the dependent claims.

Preferred embodiments of the invention are described in more detail below. In the preferred embodiments, a device for holding the cartridges from an ink-jet printer and keeping them supplied with ink comprises a container divided into two chambers. The lower chamber is filled with ink and the upper chamber contains a seat for housing one or more cartridges. The cartridges are automatically supplied with new ink drawn from the lower chamber by means of porous elements having a capillary structure, which are immersed in the ink and communicate with the cartridges by means of a hole in one of their walls.

The user of an ink-jet printer has one of these cartridge holding devices which he uses to replenish the ink in used cartridges. He can also keep filled cartridges in it until they are required for use. Thus he can have one cartridge re-filling while another one is in use in the printer, and will thus always have a spare ready for use.

By use of such a device it is not necessary to throw away used cartridges that could be refilled. However, the refilling operation is much more attractive because it does not involve much waste of time, and because the risk of dirtying the hands and the equipment or surrounding objects is minimised.

The cartridges can be made with separate compartments for different colored inks, in which case the lower chamber is correspondingly divided and there is a separate porous element for each compartment.

Brief Description of the Drawings

These and other features will be clearer from the following description of several preferred embodiments given by way of non-limiting examples and with reference to the accompanying drawings, in which:

Fig. 1 is a section of a device embodying the invention for holding a cartridge for a printing head and keeping it supplied with ink;

Fig. 2 is a section along the line II-II of Fig. 1;

Fig. 3 is a section of the container of Fig. 1, adapted to contain a head integral with the appropriate reservoir;

Fig. 4 is a section of the container of Fig. 3, containing an integral printing head;

Fig. 5 shows a device embodying the invention adapted to contain two different cartridges;

Fig. 6 is a section of Fig. 5 along the line VI-VI;

Fig. 7 shows a device embodying the invention adapted to contain two different integral heads, one with inks of different colors;

Fig. 8 is a section of Fig. 7 along the line VIII-VIII;

Fig. 9 shows a device embodying the invention adapted to contain four integral heads;

Fig. 10 is a section along the line X-X of Fig. 9;

Fig. 11 shows a cartridge within an appropriate

support adapted to be inserted into the device of one of Figures 4, 7 and 9;

Fig. 12 shows a device embodying the invention adapted to contain an integral head and a corresponding cartridge of reduced size;

Fig. 13 is a section along the line XIII-XIII of Fig. 12; and

Fig. 14 is a section along the line XIV-XIV of Fig. 13.

Detailed Description of the Preferred Embodiments

Referring to Fig. 1, the reference numeral 10 designates a container in the form of a substantially parallelepipedal box defined by rigid lateral walls 12 and a base wall 14 integral with the lateral walls 12.

A wall 18 at a certain distance from the base wall 14 is disposed in the lower part 16 of the container 10. The wall 18 is also rigid and parallel to the wall 14. The wall 18 is connected along its edge 19 to the lateral walls 12 at a predetermined distance from the base wall 14 so as to divide the inner space of the container 10 into a lower chamber 20 and an upper chamber 22.

The wall 18 is provided with a hole 24 through which an element 26 of porous material with high capillarity is passed. The element 26 is anchored to the edge of the hole 24 by means of a rubber ring 28 and projects above the wall 18 via one end 27 towards the interior of the upper chamber 22, while in the lower chamber 20 it extends as far as the vicinity of the base wall 14.

The lower chamber 20 is filled with ink via the hole 24 before the capillary element 26 is fixed there and forms an ink container 25, as will be explained hereinafter, to supply ink to the used cartridges or integral heads.

The upper chamber 22 comprises a seat for accommodating the cartridge, formed by ribs 29, 30 projecting from the lateral walls 12 into the interior of the chamber 22 and serving as a guide and support for a cartridge 32 of a separate printing head which cannot be seen in the drawings. The cartridge 32 (Figures 1 and 2) comprises a reservoir 34 filled with a spongy absorbent material 35 impregnated with ink.

Figures 3 and 4 show the container 10 of Fig. 1, its internal structure being modified so that it is adapted to contain a cartridge or reservoir 40 integral with the appropriate printing head 42 (Fig. 4), also referred to as an integral printing head.

The reservoir 43 of the head 40 comprises a lower projecting part 46 to the exterior of which a multilayer plate 48 carrying the nozzles for dispensing drops of ink is fixed.

As is known, the plate is manufactured by typical methods for integrated circuits and contains the expulsion chambers, each containing a heating element and the relevant electrical connections and the feed passages of the chambers, which cannot be seen in the drawings. These passages are connected between the said chambers and a duct 39 (Fig. 4) formed in a wall 49 of the projecting part 36.

The structure of the plate 48 for the nozzles will be more readily understood from Italian Patent No. 1 234 800.

Fig. 3 shows the empty container 10 of Fig. 4. It will be noted that the wall 18' defining the ink reservoir 36 has staggered portions separated by a step 37 defining a recess 37' for accommodating the projection 46 of the head 40 of Fig. 4. A pad 38 of soft absorbent material, e.g. felt or sponge, against which the plate 48 for the nozzles rests is disposed on the step 37. The pad serves to keep the nozzles clean and to remove any ink residue deposited on the outer face of the plate 48. It will moreover be noted from Figures 1-4 that the ribs 29, 30 extend parallel to the base wall 14 along the lateral walls 12 of the container 10.

One base wall 33 of the cartridge 32 (Fig. 1) or of the reservoir 43 (Fig. 4) is provided with a through hole 54 through which the spongy material 35 passes towards the exterior. The hole 54 is disposed in such a position that, when the cartridge 32 or the reservoir 43 of the head 40 is placed in the upper chamber 22, the projecting end 27 of the capillary element 26 penetrates into the hole 54 and comes into contact with the spongy material 35, thereby creating a hydraulic connection between the container 25 and the cartridge 32 or the reservoir 43 of the head 40.

The spongy material 35 is automatically supplied with ink by capillary action when the ink is used up after a period of use on a printer. Once the cartridge 32 or the reservoir 43 has been introduced into the container 10, the upper opening 21 of the chamber 22 is then closed by an airtight cover 56 (Fig. 3), comprising a resilient or elastic pressure member 57 to keep the head fixed in its seat formed by the ribs 29, 30.

An integral printing head 40 (Fig. 4) or a cartridge 32 (Fig. 1) with no ink left can therefore be placed in the chamber 22 where it is automatically supplied with ink from the container 25 by means of the capillary element 26.

Once the cover 56 is closed, the head or the cartridge can be kept full of ink for an indefinite period of time and thus is always ready for use. There is no risk of drying or coagulation of the ink in the nozzles as the plate 48 for the nozzles is kept in a non-ventilated environment with high relative humidity. Moreover, as already stated, in order to guarantee the operation of the nozzles at any time, the pad 38 situated on the wall 37 (Fig. 3) in correspondence with the plate 48 is provided.

Figures 5 and 6 are vertical sections of a container 60 having two distinct compartments 62 and 63 separated by a partition wall 65.

The container 60 is adapted to contain a cartridge 64 full of ink of one color, e.g. black, in the compartment 62 and a cartridge 66 containing ink of three different colors in the compartment 63. Each ink impregnates a corresponding spongy body 67a, 67b, 67c, 67d (Fig. 5). The cartridge 66 is divided into three distinct chambers 66a, 66b, 66c separated by two walls 68. The base wall 69 is provided with three holes, one for each chamber 66, through which three corresponding capillary elements 70, 71, 72 supply ink to the spongy bodies 67, each with the appropriate color of ink. The three corresponding colored inks are contained in respective distinct compartments 75, 76, 77 disposed in the lower wall 78 of the container 60.

The cartridge 64 is supplied in an analogous manner by a capillary element 80 which is immersed in a reservoir 82 containing black ink.

The container 60 is closed at the top by a cover 84 which can be made in one piece or can be divided into two separate parts, one for each compartment 62 and 63.

In an analogous manner to the container 60 in Fig. 5, Figs. 7 and 8 show a container 86 embodying the invention which is adapted to supply and hold two different integral heads 87 and 88. The integral head 87 not shown in the drawing is similar to that 40 of Fig. 4 and is used for one single color, while the head 88 contains different inks in three compartments of the reservoir 89, these supplying three corresponding printing heads e.g. 88b fixed to the reservoir 89 (Fig. 8).

Fig. 9 shows a container 90 embodying the invention which is adapted to contain four distinct integral heads 91 for four inks of different colors. The four heads 91 are identical to one another and to the head 40 of Fig. 4. Fig. 10 is a vertical section along the line X-X of Fig. 9 of one of the integral heads 91.

The container 90 is divided into four independent compartments 92 separated from one another by means of partition walls 93. Ribs 94 and 96 similar to the analogous ribs 29 and 30 of Figures 1-4 are present in each compartment to support the integral heads 91.

The container 90 is closed at the top by a removable airtight cover 97. The cover 97 can be divided into two or four separate parts so that two compartments or one single compartment can be uncovered at a time.

In the multiple containers of Figures 7 and 9, the upper walls 98 and 99 respectively of each ink reservoir are stepped to allow for the passage of the projection 102 analogous to the projection 46 of Fig. 4.

The container of Fig. 9 can be modified in a simple manner so that it can accommodate four cartridges identical to one another and similar to the cartridge 32 of Fig. 1 or the cartridge 64 of Fig. 6, each filled with ink of a different color, the part 99 being made flat relative to the wall 18, as in Fig. 1.

In simple variants not shown in the drawings, the containers of Figures 3, 8 and 10 can be adapted to accommodate a cartridge 105/support 106 group, as illustrated in Fig. 11. The cartridge 105 is similar to the one designated 32 in Fig. 1, while the support 106 consists of a parallelepipedal container 108 open towards the top and comprising lateral walls 110 having internal dimensions such that it can accommodate the cartridge 105.

On one base wall 112 and in the vicinity of a wall 110', the container 108 comprises a printing head 114 comprising a chamber 118 for the ink to supply a plate 120 carrying the printing nozzles 122. The plate 120 is of the type already described hereinabove with reference to Fig. 4. The chamber 118 communicates with the nozzles 122 via a passage 126.

The support 106 is provided with coupling elements 128 for removably mounting the cartridge/support group on the carriage (not shown) of a printer.

A multi-track flat cable 130 electrically connected via one end to the plate 120 is fixed to the outer face of the wall 110' in order to apply electric pulses to the plate 120 for the expulsion of drops of ink through the nozzles 122.

A capillary element 134 is fixed to the support 106 on the interior of the wall 112 in correspondence with the chamber 118. The element 134 projects towards the interior of the container 108 so as to penetrate into a hole 136 in the cartridge 105 in order to come into contact with a spongy body 103 contained in the cartridge 105 and impregnated with ink. The element 134 transfers the ink from the sponge 103 into the chamber 118 still full of ink by capillarity, and supplies the nozzles 122.

When the cartridge 105 is empty, it can be removed from the support 106 and can be introduced into a container 10 (Fig. 1) to be refilled with ink and to be kept full for subsequent use.

Alternatively, the entire cartridge/support group 105-106 can be removed from the carriage of the printer and can be introduced into a modified container based on that of Figures 3, 8, and 10, as already explained hereinabove.

In this manner, the cartridge 105 mounted on the appropriate support 106 can be kept ready for use for an indefinite period of time.

Figs. 12-14 show another device embodying the invention, adapted to contain and hold two cartridges of reduced size referred to as lap-top cartridges.

A container 140 is divided internally by a partition wall 142 into a lower chamber 144 and an upper part 146. The upper part 146 is in turn divided into two compartments 147 and 148 by a wall 150.

A cartridge 152 of reduced size compared, e.g. to the cartridge 32 of Fig. 1 is placed in the compartment 147. The cartridge 152 rests on two supporting ribs 155, 156 disposed on the wall 142. A capillary

element 160 is fixed to the wall 142 and projects partially via one end 162 into the compartment 147 so as to contact, via a hole 153 formed in one wall of the cartridge 152, a spongy body 154 contained in its interior. In this manner, the ink contained in the lower chamber 144 supplies the cartridge 152 by capillary action via the element 160.

On the other hand, the compartment 148 is completely sealed off both with respect to the lower chamber 144 and with respect to the exterior, so that it can house a cartridge 152' (Fig. 13) inserted into a support 170 carrying an ink-jet printing head 172 of a type similar to the head 42, 46 described with reference to Fig. 4.

A cover 145 closes the upper opening of the container 140 in an airtight manner once a sealed cartridge 152 has been inserted into the compartment 147 and a cartridge 152' with the appropriate support 170 has been inserted into the compartment 148.

The support 170 comprises a chamber 174 for supplying ink to the head 172 which communicates hydraulically with the cartridge 152' by means of a porous capillary element 176 emerging from the chamber 174. The capillary element 176 penetrates into the cartridge 152' through a hole 177 (Fig. 14) in order to contact the spongy body 154, which draws in the ink to supply the chamber 174.

The compartment 147 moreover communicates with the lower chamber 144 by means of a duct 158 provided at the hole 177 of the cartridge 152 (Fig, 14) in order to keep that portion of sponge 154 appearing through the hole 177 in a damp environment and to keep the pressure in the interior of the cartridge 152 constant.

The cartridge 152 is fixed firmly in its seat formed by the ribs 155, 156 by means of a leaf spring 163 fixed to the cover 145. Moreover, the cartridge 152 is pressed against the duct 158 by an elastic member 166 disposed between one lateral wall 141 and the cartridge 152 along the axis and on the opposite side with respect to the duct 158.

It will be understood that the devices illustrated for holding a cartridge and supplying it with ink can be subject to additions or amendments with respect to its components or embodiments without thereby going beyond the scope of this invention.

Claims

1. A device for holding cartridges or reservoirs for an ink-jet printer and keeping them supplied with ink, the device comprising a container (10) having an opening (21) and a cover (56) for closing the said opening, means (18) dividing the container internally into at least one first chamber (22) accessible through the said opening and containing means (29,30) for accommodating a cartridge, and at least one second chamber (20) for containing ink for supplying a said cartridge disposed in the first chamber.

2. A device according to claim 1, in which the second chamber (20) is disposed below the first chamber (22) and comprises a capillary element (26) having one end immersed in the ink and an opposite end projecting into the first chamber and adapted to be inserted into the cartridge.

3. A device according to claim 2, in which the dividing means separating the first and second chambers comprises a wall (18) traversed by the capillary element (26).

4. A device according to claim 1, 2 or 3, in which the means for accommodating a cartridge comprises means (29,30) for supporting and holding the cartridge in a fixed position in the first chamber (22) when the cover (56) closes the opening (21).

5. A device according to claim 4, in which the supporting means comprise ribs (29,30) projecting into the interior of the first chamber (22) and a resilient element (57) fixed to the cover (56) and adapted to press the cartridge (32) against the ribs.

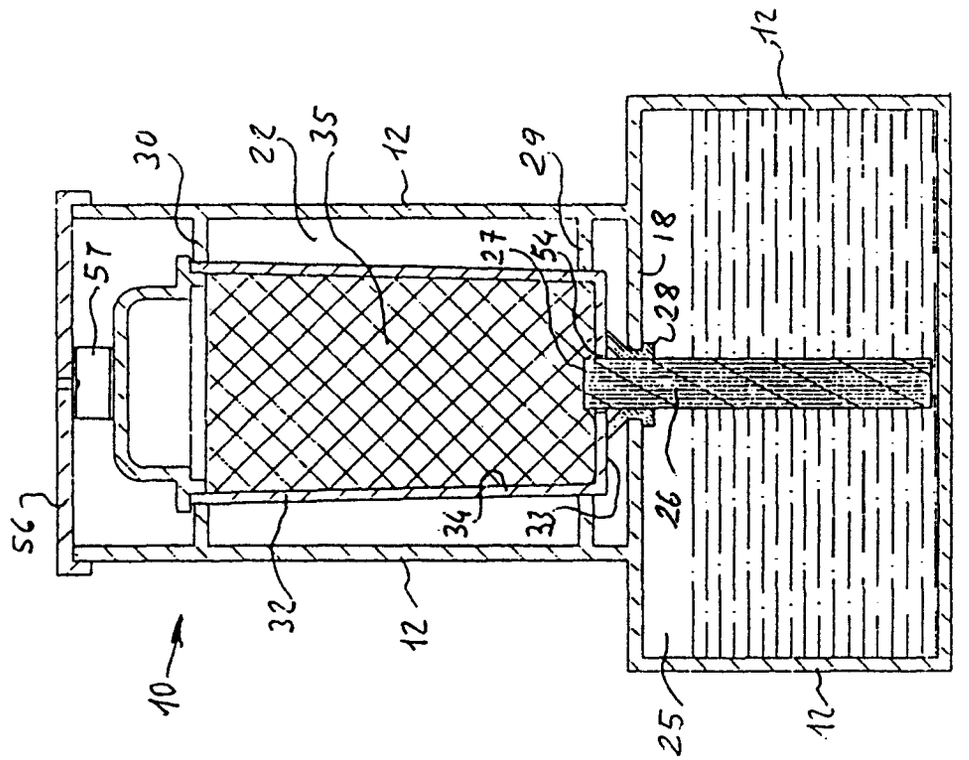
6. A device according to any preceding claim, in which the first chamber (22) comprises a recess (37') projecting towards the said second chamber (20) and adapted to accommodate the printing head of a cartridge with an integral printing head.

7. A device according to claim 6, in which the dividing means separating the first and second chambers comprises a continuous wall (18'), the wall comprising first and second portions connected to one another, the second portion being staggered to define the projecting recess (37').

8. A device according to any of the preceding claims, in which the first chamber comprises a first plurality of compartments (67a-67c) separated from one another and adapted to house cartridges (66) for different colored inks.

9. A device according to claim 8, in which the second chamber comprises a second plurality of compartments (75-77) containing inks of different colors for supplying corresponding cartridges housed in the first plurality of compartments.

10. A device according to claim 9, in which each compartment of the said second plurality comprises a capillary element (70;71;72) adapted to connect each of the cartridges hydraulically to a corresponding compartment.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12

FIG. 2

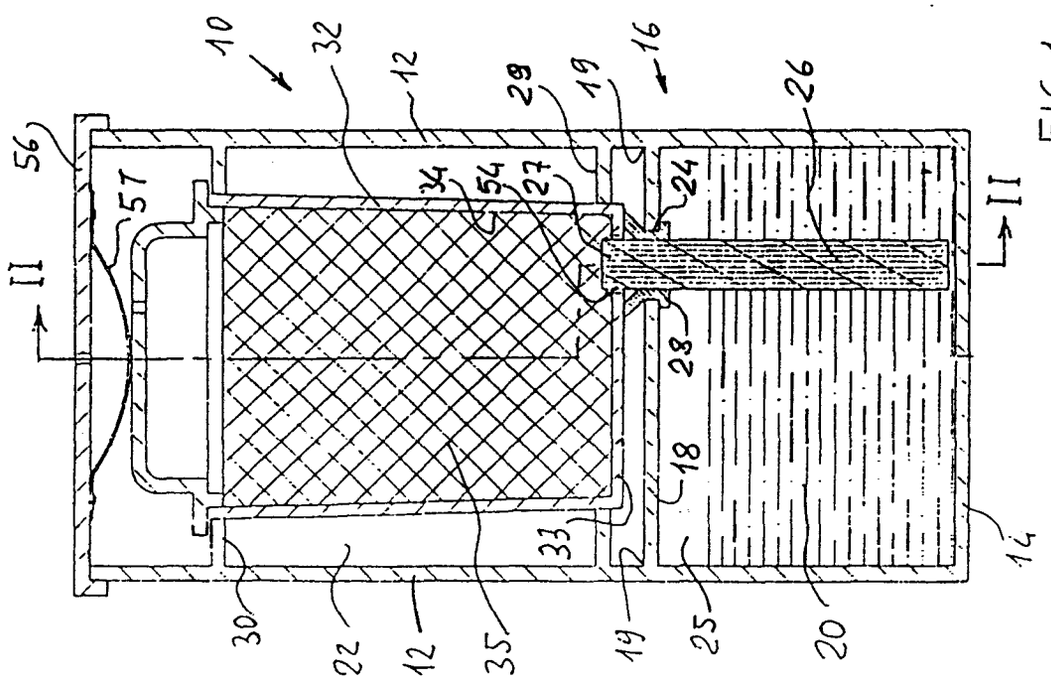
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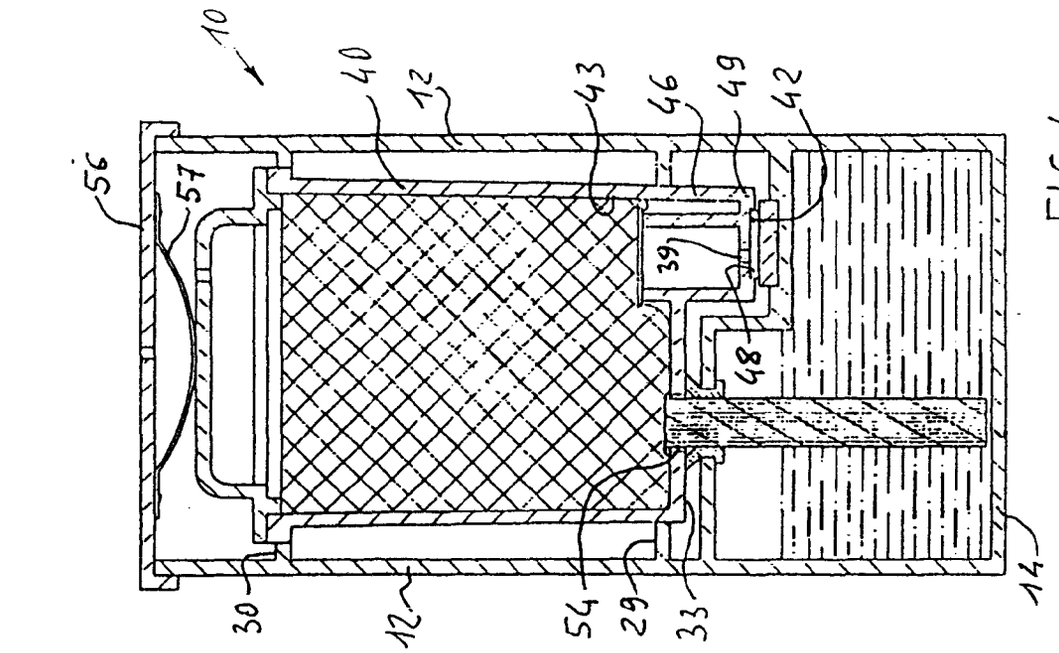
FIG. 1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12
54
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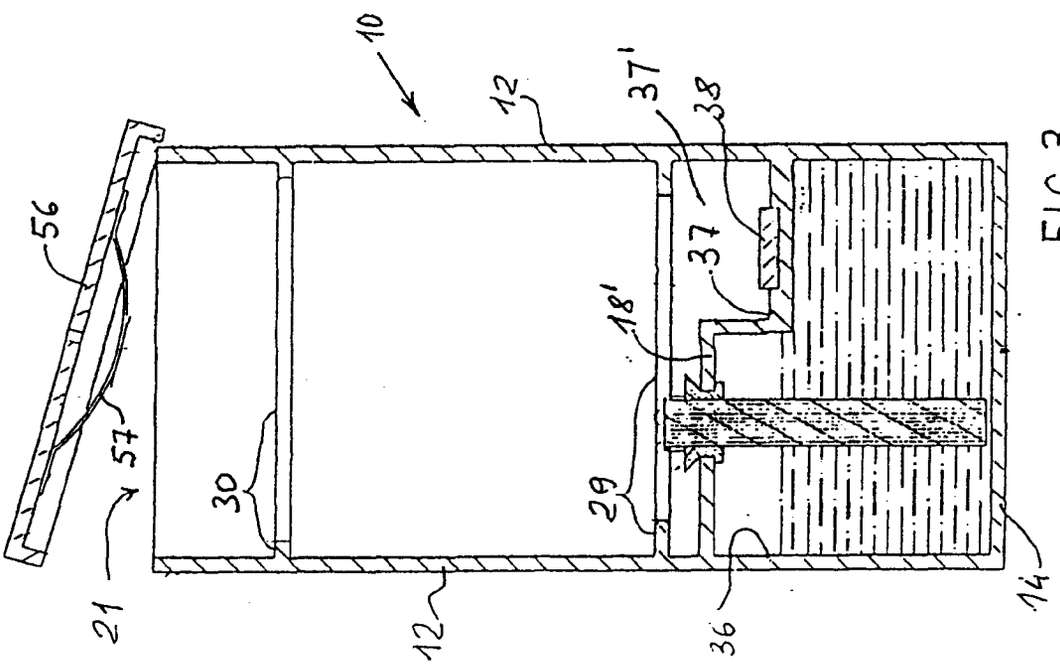
33
14

FIG.4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12
37'
38
56
37
18'
57
30
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21
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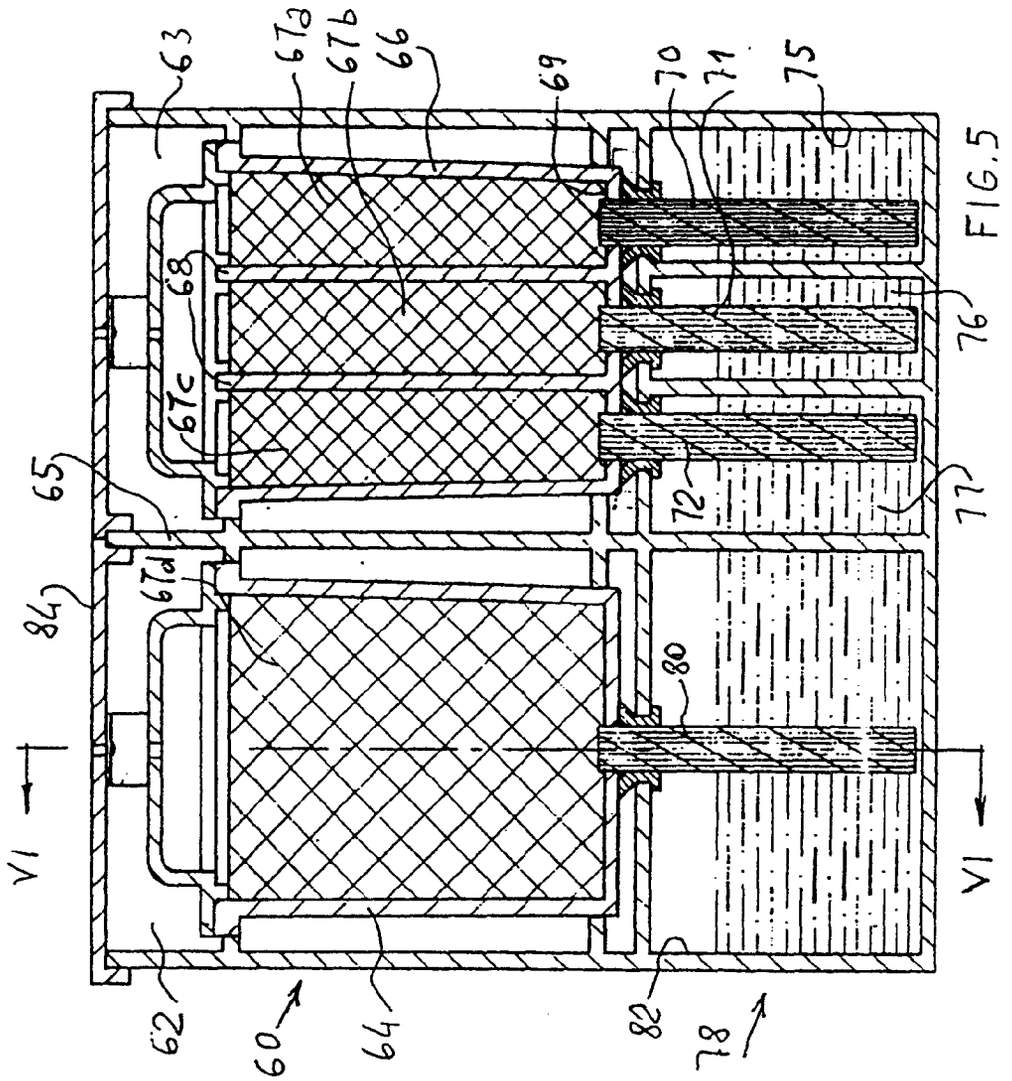
36
14

FIG.3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69
70
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77
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64
82
78

FIG.5

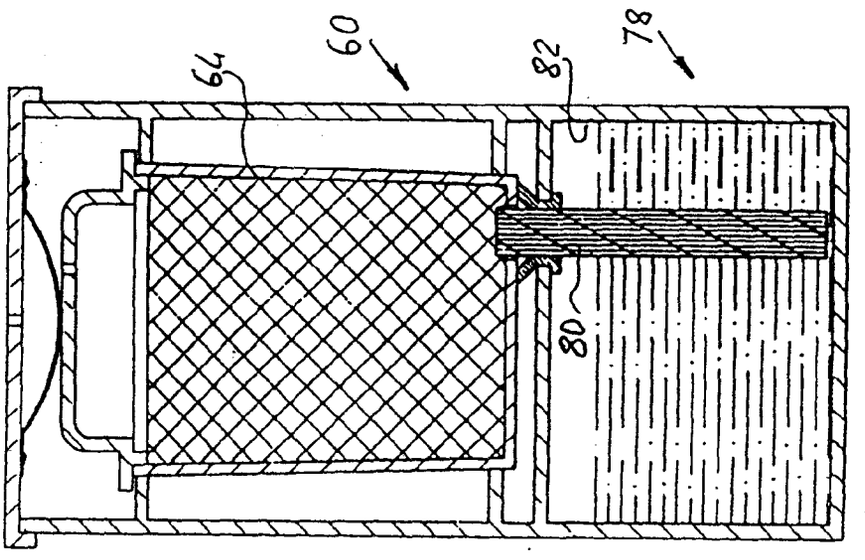
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FIG.6

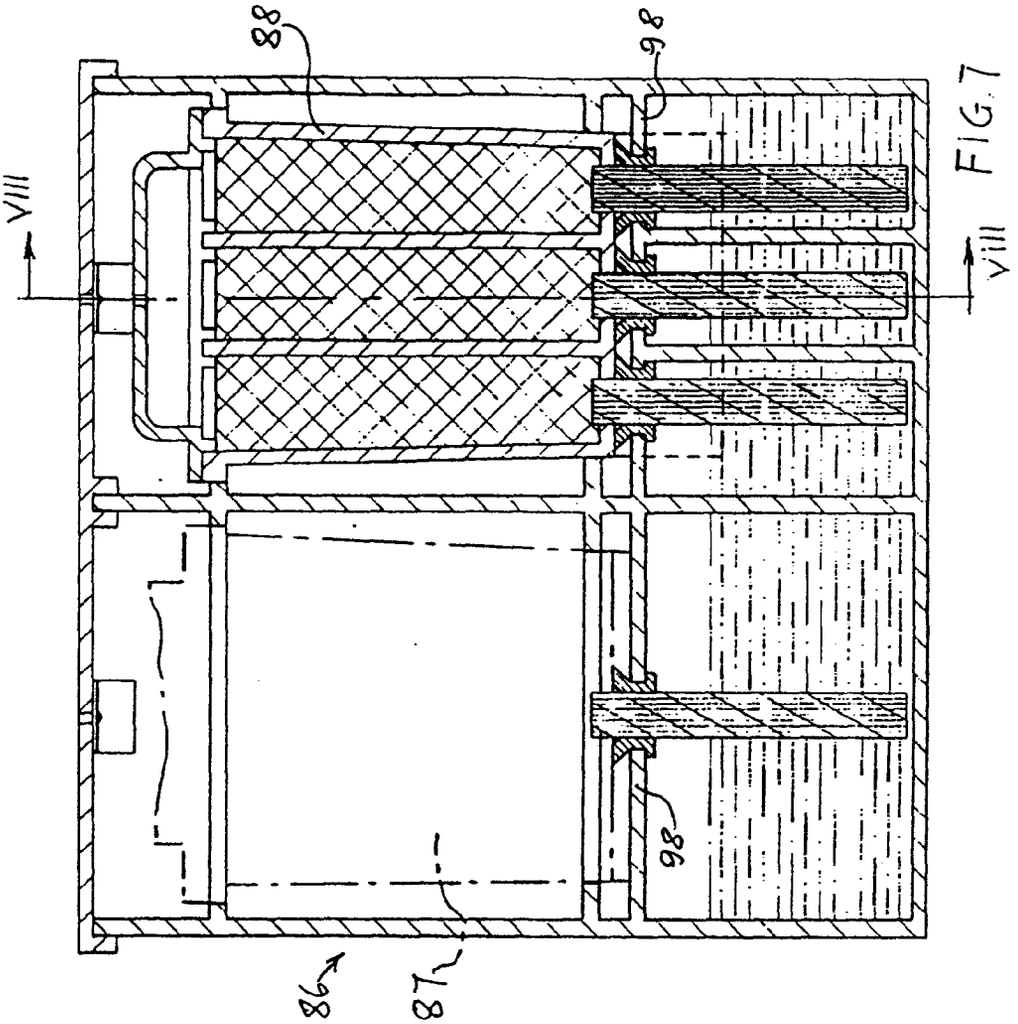

FIG.7

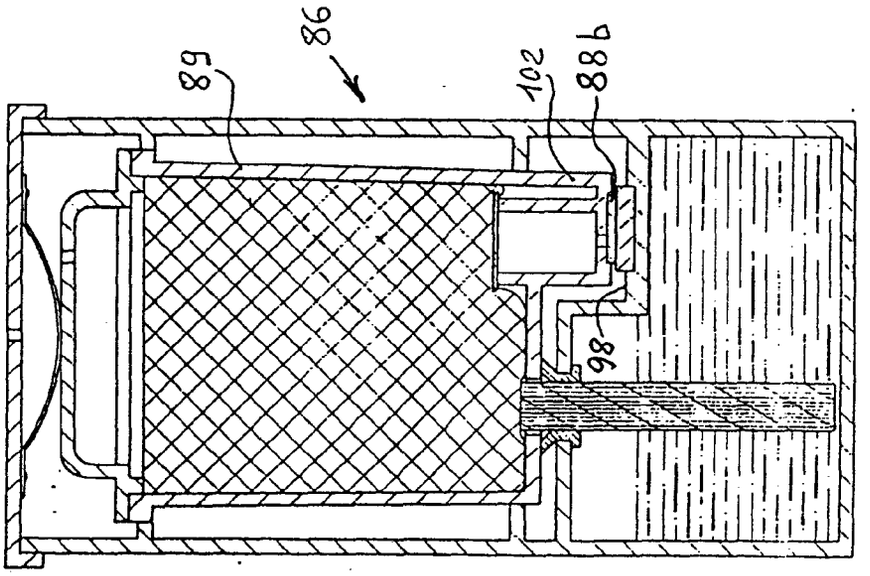

FIG.8

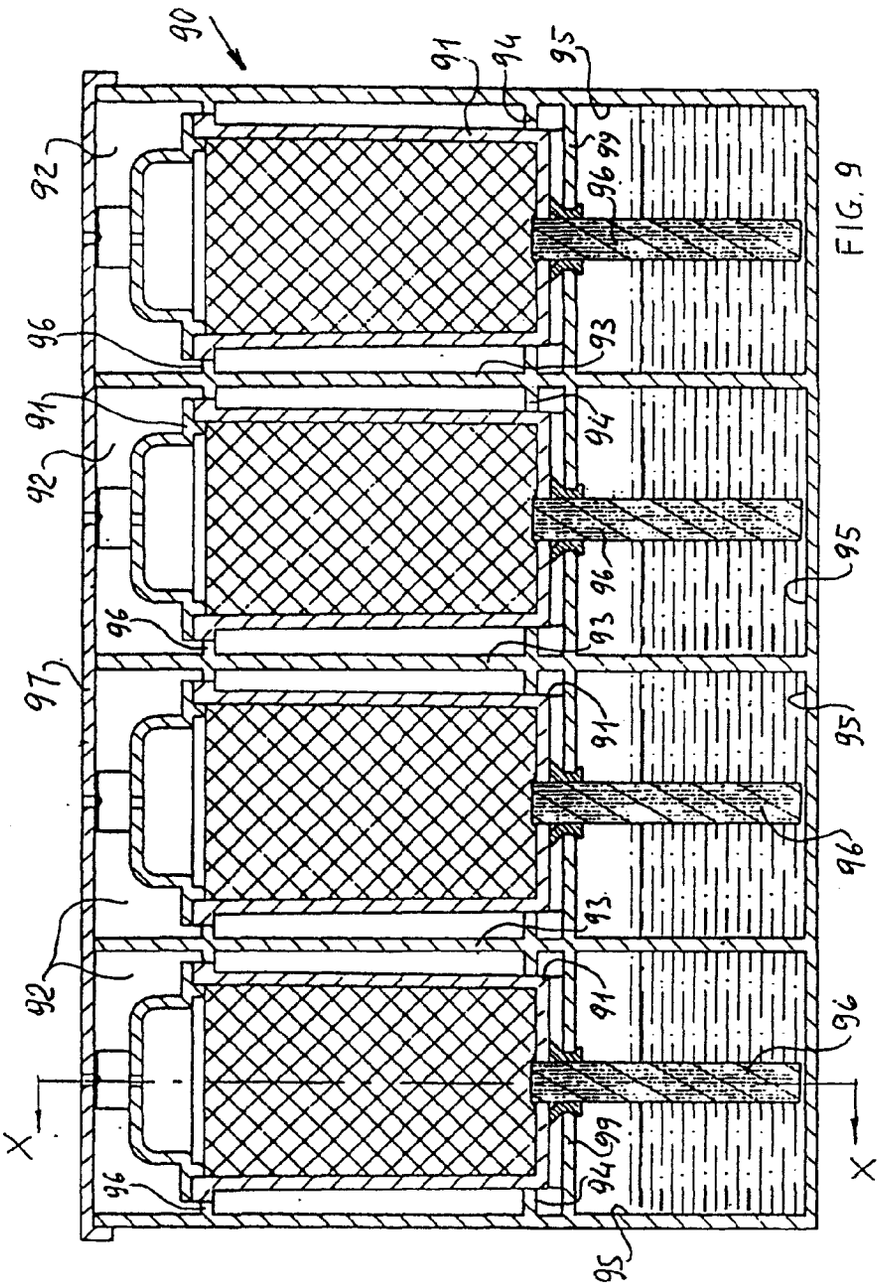

FIG. 9

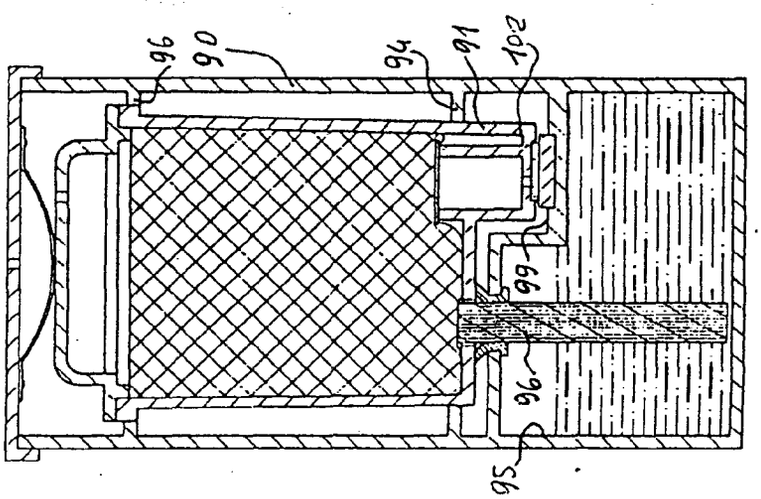

FIG. 10

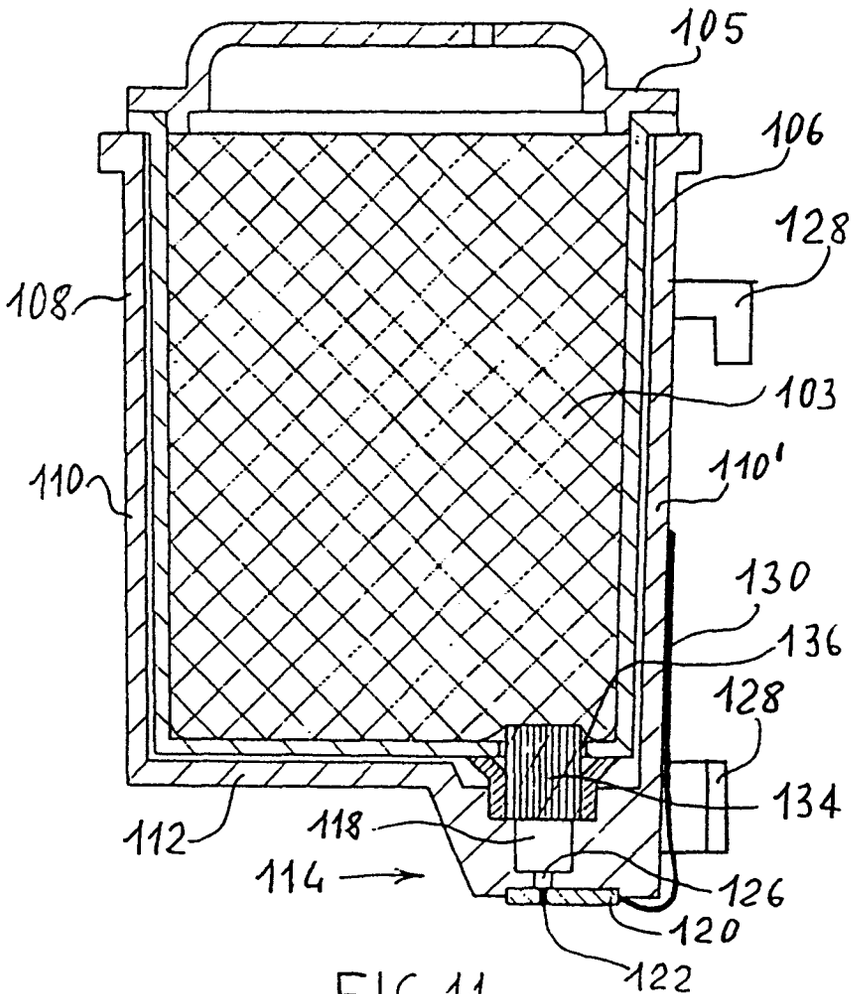
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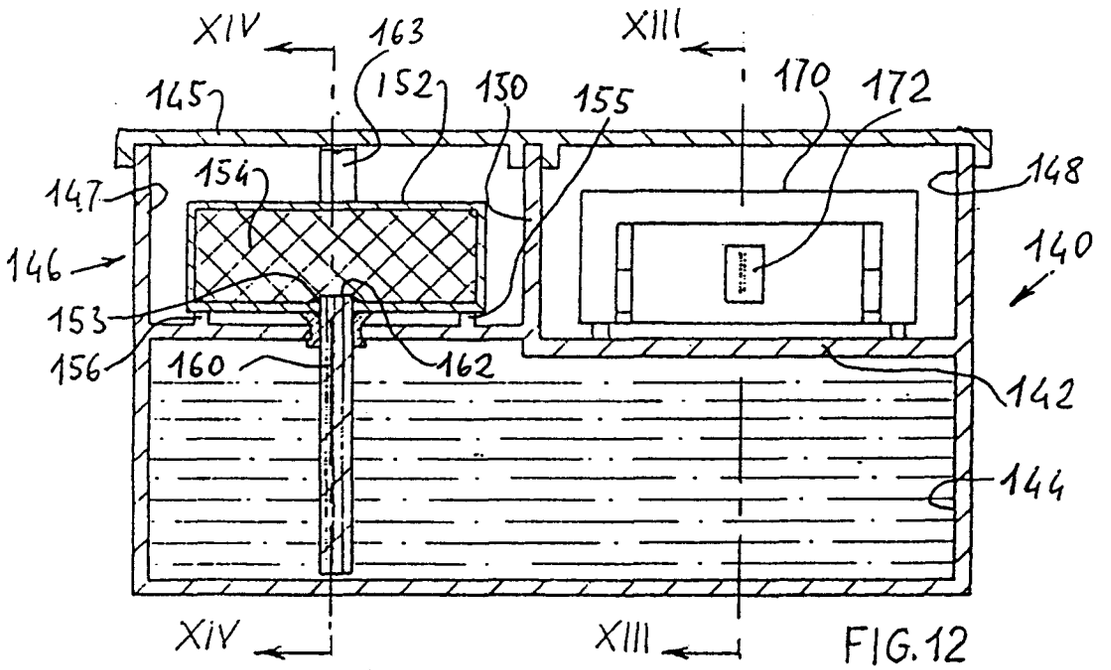
FIG. 11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XIV
XIII

FIG.12

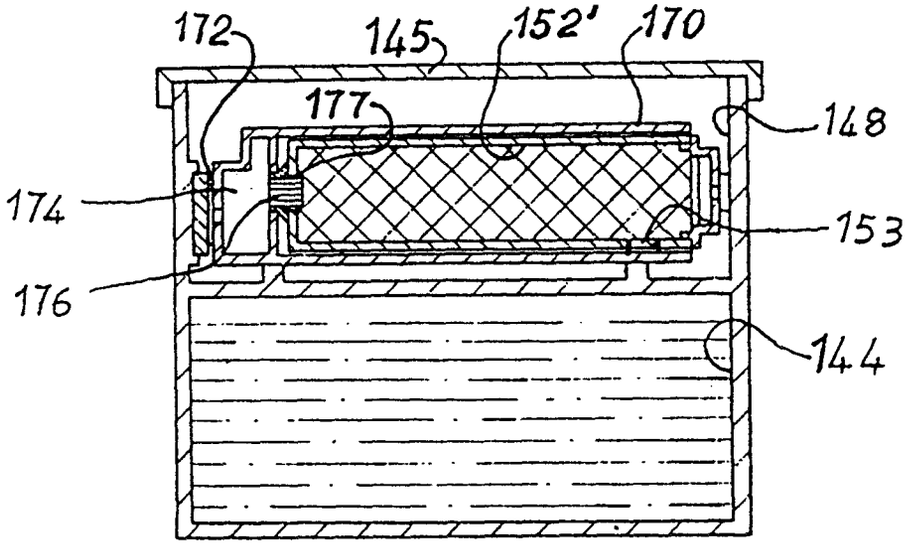
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FIG.13

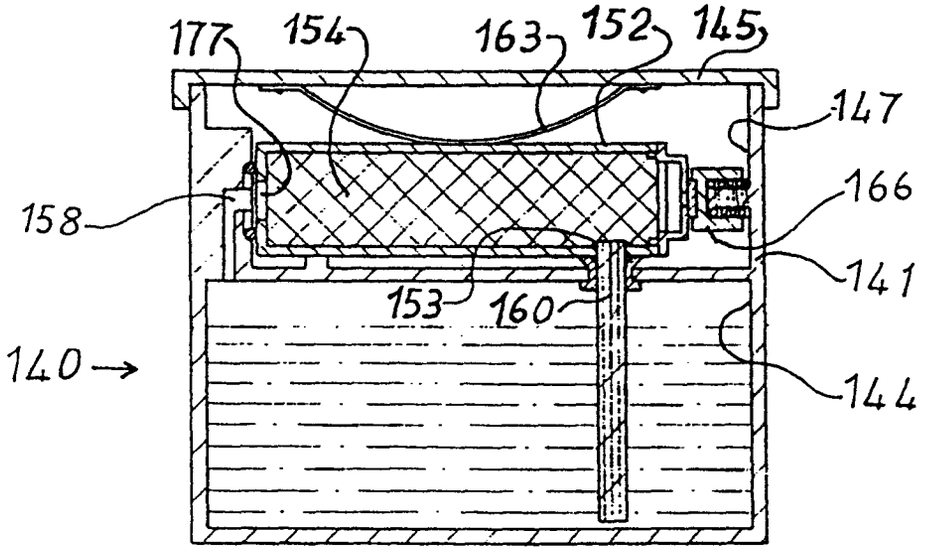
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FIG.14