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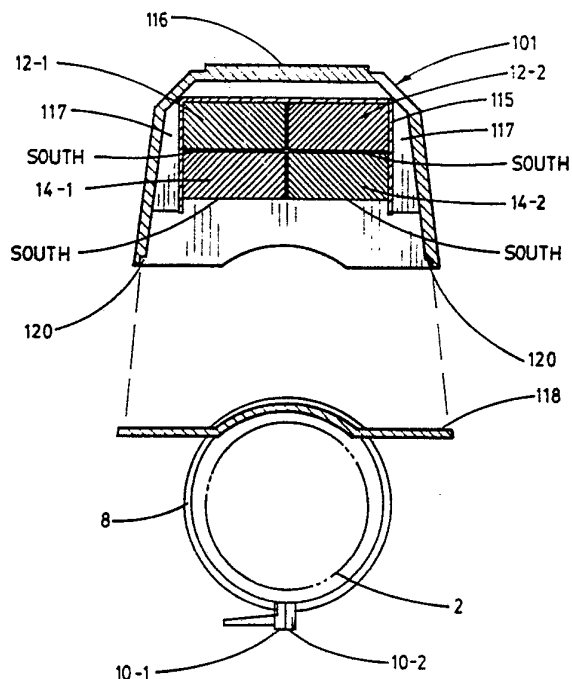
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(54) Title: MAGNETIC FLUID CONDITIONER

(57) Abstract

A compact, low cost magnetic fluid conditioner (1) is removably attached at one side of a pipe (2) through which a fluid (e.g. water, fuel or the like) is conveyed. Two pairs of ceramic bar magnets (12, 14) are arranged within the conditioner in a 2 x 2 array. Each magnet is positioned so that its south magnetic pole is facing towards the fluid-carrying pipe. Accordingly, a longitudinally-extending disk pattern magnetic field will be generated having laterally directed lines of flux which penetrate the pipe and influence a relatively large volume of fluid passing therethrough per unit of time. A second preferred embodiment includes a nonmagnetic box (115) of aluminum which further focuses the magnetic field produced. In the case where the fluid is water, the magnetic field applied by the conditioner acts to soften the water, improve the taste, and lessen the possibility of damage to the interior of the pipe along which the water passes.



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⁺ Any designation of "SU" has effect in the Russian Federation. It is not yet known whether any such designation has effect in other States of the former Soviet Union.

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MAGNETIC FLUID CONDITIONER

Related Applications

This is a continuation-in-part of copending U.S. Patent Application Serial No. 07/383,624, filed July 24, 1989.

Field of the Invention

This invention relates to magnetic fluid conditioners which, in the case where the fluid is water, functions as a low cost and compact water softener.

Background of the Invention

Magnetic fluid conditioners are known in the art for treating a fluid, such as water, which is carried by a pipe. Some magnetic conditioners are designed to extend completely around the circumference of a pipe. In cases where the pipe runs adjacent to the wall, access to the complete pipe circumference may not be possible. In other cases, a plurality of magnetic conditioners may have to be coupled together to surround the pipe so that a magnetic field of sufficient magnitude is available to penetrate the pipe.

Where sections of a magnetic conditioner lie in face-to-face alignment with one another at opposite sides of the pipe, opposing magnetic fields are created which produce a dead zone at the intersection therebetween.

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This dead zone results from the absence of intensive magnetic flux in an axial zone at a particular point within the pipe's cross-section.

Consequently, water which travels through this dead zone may not be magnetically treated, and the efficiency and effectiveness of such a conditioner is adversely affected. Likewise, where a plurality of magnetic conditioners or conditioner sections must be coupled together around a pipe, the cost, complexity, and difficulty of installation may all be undesirably increased.

Examples of conventional magnetic fluid conditioners are available by referring to one or more of the following United States patents:

4,367,143	January 4, 1983
4,568,901	February 4, 1986
4,572,145	February 25, 1986
4,605,498	August 12, 1986

Objects of the Invention

It would be desirable to have available, and it is therefore an object of the invention to provide, a low cost, compact fluid conditioner, which may be easily attached along one side of a fluid-carrying pipe so as to uniformly treat a relatively large volume of the fluid carried by the pipe.

In order to provide a magnetic fluid conditioner which may be effectively attached to just one side of a conduit, it is important to maximize the magnetic flux

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intensity incident upon the fluid within the pipe, while also maximizing the cross-sectional area of the conduit in the path of the magnetic field. It is therefore a further object of the invention to provide such a conditioner.

5 It is yet a still further object of the invention to provide a magnetic fluid conditioner which fulfills the objects stated above and still provides the further ability of maximizing the magnetic flux intensity incident across the cross-sectional area of the conduit.

10 SUMMARY OF THE INVENTION

 These and other objects are provided for by the present invention. A low cost, compact magnetic fluid conditioner is disclosed for treating a fluid (e.g. water, fuel, or the like) carried by a pipe. The magnetic fluid
15 conditioner of the present invention uses a "disk pattern field generation" to uniformly direct magnetic flux across the fluid conduit at a high intensity uniformly over the cross-section. The conditioner is provided with an arcuate surface against which the pipe is received to
20 establish a flush fit therebetween. A pair of outwardly-extending straps or belts is provided to releasably attach the conditioner to one side of the pipe.

 In a first preferred embodiment, the conditioner includes a generally hollow, nonmagnetic housing in which
25 a 2 x 2 array of magnets is retained. The magnets are high intensity CB-60 ceramic bar magnets formed from powdered barium ferrite. Each bar magnet is aligned so that the south magnetic pole thereof is facing the fluid-carrying pipe. Accordingly, a relatively long magnetic
30 field is created with laterally projecting lines of flux that penetrate the pipe and treat a relatively large volume of fluid per unit of time.

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5 In a second preferred embodiment, a metallic nonmagnetic box envelopes the bar magnets to provide a focusing mechanism for the magnetic flux. The box does not have a bottom surface, i.e., the open bottom of the nonmagnetic box faces the pipe. The box sits inside the conditioner housing, surrounding the bar magnets which are configured in a 2 x 2 array, as discussed above with respect to the first preferred embodiment.

10 The metallic box, which is aluminum in the preferred embodiment, directs the magnetic flux so that the intensity of the incident magnetic flux is even more uniform than the first disclosed embodiment, and at a higher intensity, across the cross-section of the fluid conduit. The box is nonmagnetic and acts to focus the
15 flux lines by resisting the magnetic flux, thereby directing the flux lines in a single uniform fashion.

In the case where the fluid is water, the fluid conditioner functions as a water softener that reduces hardness, improves taste, and minimizes the possibility of
20 damage to the interior of the pipe.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention, both as to its organization and manner of operation, together with further objects and advantages, may be understood by reference to
25 the description, taken in connection with the accompanying drawings.

Figure 1 is a graphical depiction of the magnetic field caused by a core aligned next to a pipe;

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Figure 2 is a graphical depiction of the affect of pole stabilizers on the magnetic field shown in Figure 1;

5 Figure 3 is a graphical depiction of the magnetic field produced by a ceramic magnetic core utilized in the configuration of Figure 1;

Figure 4 is a graphical depiction of the preferred magnetic flux line utilized in the preferred embodiments of the present invention;

10 Figure 5 is a graphical depiction of the magnetic field produced by the preferred embodiments of the invention;

15 Figure 6 shows the magnetic fluid conditioner which forms a first preferred embodiment of the present invention removably attached to one side of a fluid-carrying pipe;

Figure 7 is a top view of the magnetic fluid conditioner of Figure 6;

20 Figure 8 is a bottom view of the fluid conditioner of Figure 6;

Figure 9 illustrates two pairs of bar magnets which are to be received within the fluid conditioner of Figure 6;

25 Figure 10 is a cross-section of the fluid conditioner of Figure 6 showing cover and shell housing members being connected together with the bar magnets of Figure 9 installed within the housing shell;

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Figure 11 is a cross-section of the fluid conditioner of Figure 6 showing cover and shell housing members being connected together with the bar magnets of Figure 9 installed within the housing shell;

5

Figure 12 is a bottom view of the shell housing member of the first preferred embodiment showing the bar magnets of Figure 9 received therewithin;

10

Figure 13 is an exploded view of the magnetic fluid conditioner which forms a first preferred embodiment of the present invention relative to a fluid-carrying pipe;

15

Figure 14 shows the magnetic fluid conditioner which forms a second preferred embodiment of the present invention removably attached to one side of a fluid-carrying pipe;

Figure 15 shows a bottom view of the fluid conditioner of Figure 14;

20

Figure 16 shows a bottom view of the shell housing member of the second preferred embodiment showing the bar magnets received therewithin;

Figure 17 shows an exploded view of the magnetic fluid conditioner which forms a second preferred embodiment of the present invention relative to a fluid-carrying pipe; and

25

Figure 18 shows a cross-section of the fluid conditioner of Figure 14 showing the cover and shell housing members being connected together the bar magnet installed within the housing shell.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following description is provided to enable any person skilled in the art to make and use the invention and sets forth the best modes contemplated by the inventor of carrying out his invention. Various
5 modifications, however, will remain readily apparent to those skilled in the art, since the generic principles of the present invention have been defined herein.

Magnetic fields are generated in an undetermined
10 pattern as a general rule. The fields generated are primarily used and controlled for their holding or attracting and repelling purposes. Further control over the magnetic field may be obtained by using pole stabilizers that increase the lift strength of the magnets
15 themselves.

Figure 1 shows an example of the varied directional pattern or field P generated by a simple magnetic core M. Magnetic flux lines are projected in straight lines at different angles relative to each other
20 which lines will eventually be curved or bent as they extend far from the core and become weaker.

If the desired result is to treat a fluid F passing through a conduit C next to the core M, then using this type of a magnetic core would not be advisable
25 because most of the fluid F would pass by the field entirely and would not be affected by the field pattern P. When the fluid F is affected, the molecules and particles and/or structures involved align themselves in the same direction as the flux lines. So in Figure 1, not only
30 does the majority of the fluid F pass the field P without

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being affected at all, but that portion of the fluid F treated becomes structured in a manner nonconductive to the desired result.

5 Pole stabilizers S may be used to increase the efficiency of the magnetic cores M. As shown in Figure 2, pole stabilizers S will increase the lift force of a magnetic core M due to the tightening of the magnetic bands or flux pattern P generated from the cores M. Pole stabilizers S tighten the flux pattern P by pulling the
10 flux lines toward themselves. This is how metallic objects such as screws become magnetized. They simply sit on a magnet for a time. However, the angles of the flux lines P affected by the pole stabilizers S are now even less effective toward proper treatment of the fluid.

15 Many researchers are deceived by the apparent increase in the strength of the assembly when this configuration is used. Although the lift is increased, the field P is actually decreased, because the flux lines P are actually drawn out and away from the conduit C or fluid F, and the line penetration is diminished as a
20 result. This type of unit becomes less effective than using the simple core without any adaptations at all.

It is best to understand that there are two qualities about the field which affect the fluid:

- 25 (1) The magnetic "pressure," or flux density, of the field. The field must be in contact with the fluid. With stabilizers, the fields are actually drawn out of and away from the pipe; and

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- (2) The "angle" of the flux lines. The stabilizers will draw the lines of flux in angles nonbeneficial to treatment much the same as shown in original Figure 1.

5 As discussed, the molecules X in a fluid F are, as a rule, very unstructured and unorganized. However, as shown in Figure 3, the elements X contained in fluid F tend to line up with the magnetic bands P when a magnetic field is generated through a conduit C.

10 The elements X are placed in a pattern relative to each other. This pattern allows the elements X to take up less space in the volume of the fluid F and thereby allow more substances in. Under certain conditions, depending on the amount of solids in the fluid F, this
15 will have an effect of softening the fluid F. The preferred embodiments of the invention use ceramic magnetic cores M' to provide greater field strength.

 As shown in Figure 4, for optimum effect the elements X of the fluid F must be organized and oriented
20 in such a manner that they will all line up in the same direction and also be able to be "stacked" together and take up as little space as possible. The best way to "stack" these elements X is to seclude the one magnetic band P₀ that is most beneficial for this effect and then
25 duplicate it.

 To achieve this, it is necessary to bend the existing fields P or force them into a perpendicular trajectory. Since using a ferrous material to "squeeze" the field P would not work due to the attracting qualities

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of the metal, and using nonferrous materials would not cause any effect at all, the only way to change the natural direction of the magnetic bands is to counter them with an equal force or unpenetrable field.

5 As shown in Figure 5, this is accomplished in the present invention by configuring the cores M' in a sequence that forces the fields P to be generated out through the center of the device.

10 The magnetic field P is generated out of the entire core M. However, like poles (and fields), cannot intersect. Therefore, the like fields repel each other, and are forced away from each other.

15 It is not possible for two like pole magnetic fields to penetrate each other. However, if two magnetic fields are forced together, the field must go somewhere. When the cores are configured in the method stated herein, the field is forced into a pattern that forms the "Disk Pattern Field Generation."

20 This is easily demonstrated by using a sensitive compass and passing a strong magnetic core near it. The distance of influence, even from one of the more powerful cores, will not be as great as that of the Disk Pattern Field Generation Device.

25 The compact, low cost magnetic fluid conditioner which forms the preferred embodiments of the present invention is described while referring to the following drawings, where Figure 6 shows the fluid conditioner 1 removably attached to a fluid-carrying pipe 2. The pipe 2 with which conditioner 1 is to be associated may convey

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any suitable fluid, such as, but not limited to, water or fuel.

In the aforementioned cases, fluid conditioner 1 may be regarded as a water softener or fuel conditioner, respectively. However, the type of fluid traveling through pipe 2 is not to be regarded as a limitation of the present invention.

As shown in Figures 6-8 of the drawings, a first preferred fluid conditioner 1 of the present invention is characterized by a generally rectangular housing 4. Other embodiments of the invention may have a differently-shaped housing without affecting the utility of the invention. For example, in a second preferred embodiment discussed below, the housing has a generally square shape.

It is preferable that the housing 4 be manufactured from a nonmagnetic material, such as molded plastic, which will not in any way affect any magnetic fields produced. The housing 4 should be essentially transparent to the magnetic fields. One side of housing 4 includes an arcuate-shaped pipe receiving section 6, within which to locate the fluid pipe 2. The precise curvature of the arcuate pipe receiving surface 6 may vary from housing to housing, depending upon the diameter of the pipe 2. However, by virtue of the pipe receiving surface 6, a relatively flush and stable fit is possible between fluid conditioner 1 and fluid pipe 2.

While the appearance of fluid conditioner 1 and, more particularly, the continuous surface-to-surface contact established between the pipe receiving surface 6 and the fluid pipe 2, is considered to be unique, such appearance forms no part of the claimed invention,

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inasmuch as the aforementioned appearance of the fluid conditioner 1 is disclosed and claimed in copending U.S. design patent applications.

Fluid conditioner 1 includes means for conveniently attaching the housing 4 to fluid pipe 2. The attachment means includes a pair of thin straps or belts 8 which extend through slots 7 at each of the opposite ends of the conditioner 1 so as to surround pipe 2.

The ends of the straps 8 include a complementary pair of fasteners (designated 10-1 and 10-2 in Figure 10) which may be mated (e.g. snap-fit) together so as to reliably attach housing 4 to pipe 2. When it is desirable to remove the conditioner 1 from pipe 2, fasteners 10-1 and 10-2 are merely disconnected from one another. Economically, it is also found that plastic ties may be used as fasteners which are cut and discarded when the conditioner is removed.

In accordance with the present invention, and referring to Figure 4 of the drawings, magnetic means are provided to enable fluid conditioner 1 to generate a sufficient magnetic field to affect the fluid in the pipe. The magnetic field is characterized by lines of flux that will penetrate the fluid-carrying pipe and thereby influence the fluid passing therethrough.

More particularly, in the preferred embodiments, two pairs of bar magnets 12-1, 12-2, and 14-1, 14-2 are arranged within conditioner 1 in a particular alignment relative to one another to generate the magnetic field and associated flux pattern that will penetrate the fluid-carrying pipe. The flux pattern will flow along the longitudinal axis of said pipe so as to influence a

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relatively large volume of fluid passing through the pipe at any instant of time. Other embodiments are viewed, however, where other bar magnet configurations are implemented, such as a 1 x 2 matrix array. By bringing all lines of flux parallel in respect to themselves, all molecules will line up in a manner such that they will fit or stack together closer, thereby requiring less space.

By way of example, magnets 12 and 14, which are suitable for use in fluid conditioner 1, are high intensity CB-60 ceramic magnets. Ceramic magnetic cores are considered advantageous for their ability to produce very controlled and dense magnetic fields and flux patterns. As will be understood by those skilled in the art, CB-60 refers to a ceramic magnet rated grade 8 and composed of powdered barium ferrite, wet pressed and ground to size. Such magnets are commercially available from All Magnetics, Inc. of Placentia, California.

The particular alignment of bar magnets 12-1, 12-2, and 14-1, 14-2 relative to one another and the installation of such magnets into the housing 4 of fluid conditioner 1 are now described while referring concurrently to Figures 10-13 from the drawings. In order to accommodate the magnets 12 and 14 in the desired alignment, the housing of the first preferred conditioner 1 is provided with a generally hollow housing shell 16 having one open end and a detachable housing cover 18. The detachable housing cover 18 provides the arcuate pipe retaining surface (designated 6 and best shown in Figure 13) along its exterior.

A pair of hollow sleeves 20 extends outwardly from each end of housing shell 16. A pair of legs 22 extends outwardly from each end of the interior of the

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housing cover 18 in suitable alignment with respective sleeves 20. In the assembled arrangement, each leg 22 of cover 18 is received within and mated to a respective hollow sleeve 20 of shell 16 so as to reliably attach cover 18 across the open end of said shell.

Pairs of longitudinally spaced retaining walls 23 and 24 extend in parallel alignment with one another across the interior of hollow housing shell 16. The pairs of bar magnets 12-1, 12-2, and 14-1, 14-2 are received in a particular predetermined alignment between the pairs of retaining walls 23 and 24 during the assembly of conditioner 1 and prior to the attachment of housing cover 18 to housing shell 16. Magnets 12 and 14 are sized to form a snug, friction fit against retaining walls 23 and 24 so as to prevent a displacement of the magnets out of their predetermined alignment.

The details of the particular alignment of bar magnets 12-1, 12-2, and 14-1, 14-2 are now disclosed. It has been found that a magnetic field can be generated along the longitudinal axis of fluid-carrying pipe 2 with laterally-extending lines of flux that penetrate said pipe and influence a relatively large volume of fluid traveling therethrough by arranging the magnets in a 2 x 2 array with all of the south magnetic poles facing towards pipe 2 (best illustrated in Figures 10 and 13). That is, the first pair of magnets 12-1 and 12-2 are arranged side-by-side one another atop the second pair of magnets 14-1 and 14-2, which are also arranged side-by-side one another. Each magnet of the first and second pairs thereof is positioned within the fluid conditioner 1 so that its south magnetic pole faces towards the fluid pipe 2 and its north magnetic pole faces away from fluid pipe 2.

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By virtue of the foregoing magnetic alignment, it has been found that with water passing through pipe 2, the applied magnetic field acts to reduce hardness. More particularly, chlorine and sulphur particles in water remain soluble, while charged mineral particles remain in solution. Moreover, mineral scale is attracted from the walls of the pipe back into a dissolved state. What is more, metal particles are less likely to be stripped from lead pipes. Accordingly, the water should be softer and should taste better while being less likely to damage the inside of the pipe through which it passes.

Because the preferred alignment of magnets 12-1, 12-2, and 14-1, 14-2 produces a magnetic field having laterally-extending lines of flux that penetrate the fluid-carrying pipe 2, it may be noted that only a single fluid conditioner 1 is needed for attachment along one side of the pipe. This is particularly advantageous in situations where the pipe is located adjacent a wall and access to the complete periphery of the pipe is not possible. Of course, it is still in the scope of the present invention to attach more than one fluid conditioner to said pipe when complete access thereto is otherwise available.

A second preferred embodiment of the invention is illustrated in Figures 14 through 18. Therein, like elements retain like reference numbers.

As illustrated in Figure 14, the second preferred embodiment of the invention 101 has more of a boxed shape than the first preferred embodiment. A recess 106 runs along the bottom surface of the magnetic conditioner 101 for receiving a fluid conduit 2, as discussed above with respect to the unit 1.

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As shown in Figure 15, the bottom surface of the unit 101 includes fastening slots 107 disposed on either side of the recess 106. In this embodiment, the fastening slots 107 include a directional means 108 to better allow straps (not shown) to surround the pipe. These directional means 108 direct the straps outwardly from the recess 106 and away from the most direct contact with the pipe 2.

Figure 16 illustrates the magnetic fluid conditioner 101 with the bottom surface removed. Magnets 14-1, 14-2 are disposed within the conditioner in the same configuration as discussed above. A metallic box 115 encapsulates the magnetic bars to focus the magnetic field produced therefrom. In the preferred embodiment of the invention, the magnetic box is formed from aluminum, which is both economically feasible and produces the best focusing ability for the magnetic flux.

Support bars 117 extend inward from the side walls of the casing 116 to position the metallic box 115. The walls of the container 116 also include a ledge portion 119 for snap-fit receiving the bottom surface of the box.

A cross-section of the magnetic fluid conditioner 101 looking along the fluid conduit 2 is illustrated in Figure 18. As seen in Figure 18, the magnets 12-1, 12-2, 14-1, 14-2, are configured with their south magnetic poles facing the fluid conduit 2. The magnetic bars are situated inside of a metallic box 115, which is held in position by supports 117. Recesses 120 are formed within the outer casing 116 to snap-fit receive the bottom surface 118, which is placed in frictional contact with the fluid conduit 2.

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Figure 19 shows a second exploded portion of the second preferred embodiment 101 of the present invention. The outer shell casing 116 is formed of a nonmetallic material such as plastic, as discussed above with respect to the outer shell casing of the first preferred embodiment. A metallic box 115, which is aluminum in the preferred embodiment, fits within the outer shell casing 116 and is held in place by supports 117. The metallic box 115 has surfaces on all sides except for the bottom surface 115a. The nonmagnetic, metallic box 115 acts to repel any magnetic field produced by the magnetic cores 12-1, 12-2, 14-1, and 14-2. Aluminum has been found to be the best composition for the box 115.

Magnetic bars 12-1, 12-2, 14-1, 14-2 fit within the metallic box 115, and are placed in the same configuration as discussed above with the first preferred embodiment of the invention. These metallic bars 12-1, 12-2, 14-1, 14-2 have their south magnetic pole facing the fluid conduit 2. Once the magnetic box is frictionally placed within the outer shell casing 116, and the magnetic bars 12-1, 12-2, 14-1, 14-2 are placed within the metallic box 115, the bottom surface 118 of the outer shell is snap-fit on the outer shell casing 116 along the recess 119. The bottom surface 118 is made of the same nonmetallic material as the outer shell casing 116. The bottom surface 118 is held in place around the fluid conduit 2 by straps 8.

Because the box 115 acts to repel the magnetic field produced by the magnetic bars 12-1, 12-2, 14-1, 14-2, an even more focused and uniform magnetic field is directed across the fluid conduit or pipe 2 than the magnetic field produced by the first preferred embodiment of the present invention.

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Those skilled in the art will appreciate that various adaptations and modifications of the just-described preferred embodiment can be configured without departing from the scope and spirit of the invention. Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

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CLAIMSWhat is Claimed Is:

1. A fluid conditioner to be located adjacent a conduit in which a fluid is carried, said conditioner including a housing having a hollow compartment and magnet means located within said compartment, said magnetic means comprising at least two rectangular-shaped magnets, each having north and south magnetic poles at the respective opposite faces thereof, and being aligned side-by-side and touching one another in a first 1 x 2 matrix that is retained within the compartment of said housing such that said magnets act to magnetically repel one another and the respective south magnetic poles of said magnets face the conduit to generate a magnetic field having parallel aligned lines of flux which penetrate said conduit.

2. The fluid conditioner recited in Claim 1, wherein each of said at least two rectangular magnets is a bar magnet having a longitudinally extending axis, said bar magnets being arranged relative to the conduit, such that the longitudinally extending axes of said magnets are aligned parallel with respect to the direction in which fluid passes through said conduit.

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3. The fluid conditioner recited in Claim 1, wherein said magnetic means also includes at least two additional rectangular-shaped magnets, each having north and south magnetic poles at the respective opposite faces thereof, and aligned side-by-side and touching one another in a second 1 x 2 matrix such that said two additional magnets act to magnetically repel one another, said second 1 x 2 matrix of magnets being retained within the compartment of said housing on top of and in contact with said first matrix of 1 x 2 magnets to form a 2 x 2 matrix of magnets with the respective south magnetic poles of each of said magnets facing the fluid-carrying conduit.

4. The fluid conditioner recited in Claim 1, wherein each of said magnets is formed from a ceramic material.

5. The fluid conditioner recited in Claim 4, wherein said ceramic material is barium ferrite.

6. The fluid conditioner recited in Claim 1, further comprising means for removably attaching said housing to the fluid-carrying pipe.

7. The fluid conditioner recited in Claim 6, wherein said attachment means includes at least one strap extending from said housing around said pipe.

8. The fluid condition recited in Claim 1, further including a magnetic focusing means for focusing the magnetic field produced by said magnets upon said conduit.

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9. The fluid conditioner recited in Claim 8, wherein the magnetic focusing means is a box enveloping said magnets, the box having one open surface.

10. The fluid conditioner recited in Claim 9, wherein the box is metallic.

11. The fluid conditioner recited in Claim 10, wherein the box is aluminum.

12. The fluid conditioner recited in Claim 9, wherein the open surface of the box faces the conduit.

13. A nonmagnetic, magnetic field focusing device, comprising a magnet for producing a magnetic field and a nonmagnetic focusing means for focusing the magnetic field produced.

14. The focusing device of Claim 13, wherein the focusing means is aluminum.

15. The focusing device of Claim 14, wherein the focusing means envelopes the magnet.

16. The focusing device of Claim 15, wherein the focusing means is a box with one surface missing.

17. The focusing device of Claim 16, wherein the missing surface faces a direction where the magnetic field produced has a maximum south magnetic flux density.

18. The focusing device of Claim 17 wherein the focusing device creates a disk pattern field generation.

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19. A method for conditioning fluid travelling through a conduit, wherein a disc pattern magnetic field is generated across the conduit's cross-section, the disc pattern field being characterized by parallel magnetic flux lines extending through the cross-sectional area of the pipe.

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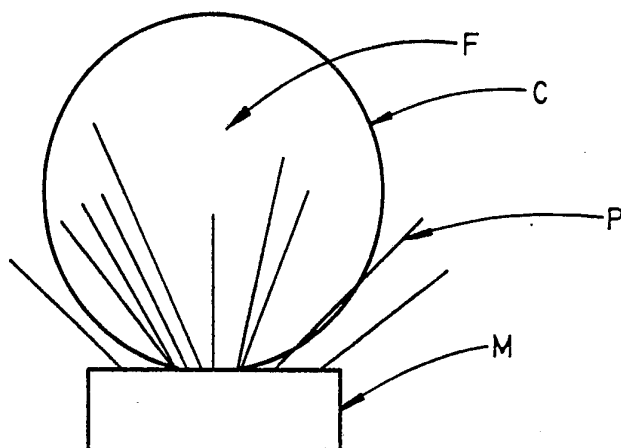


FIG. 1

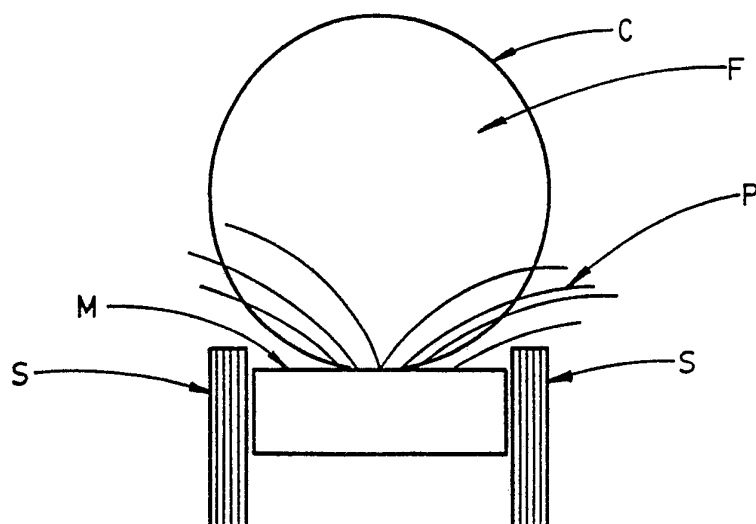


FIG. 2

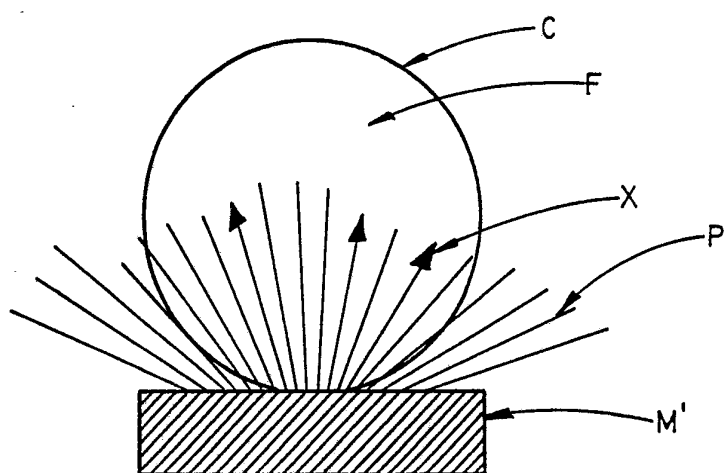


FIG. 3

SUBSTITUTE SHEET

- 2 / 9 -

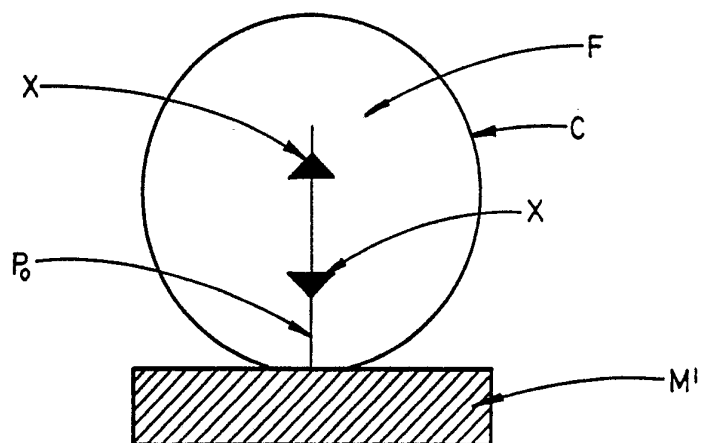


FIG. 4

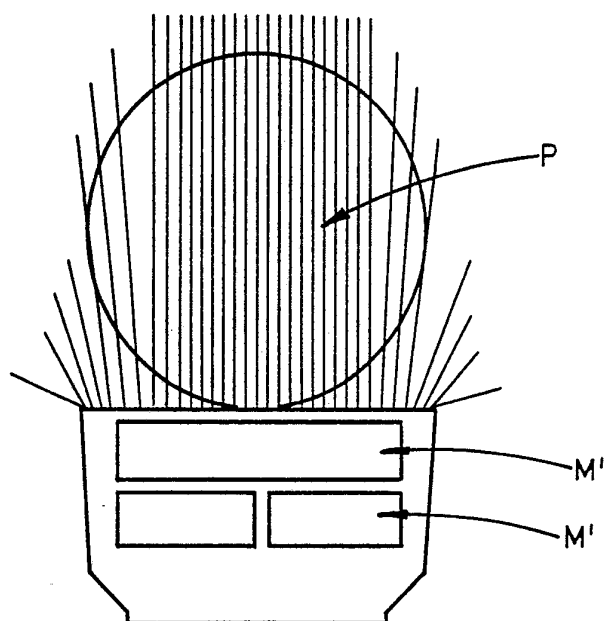


FIG. 5

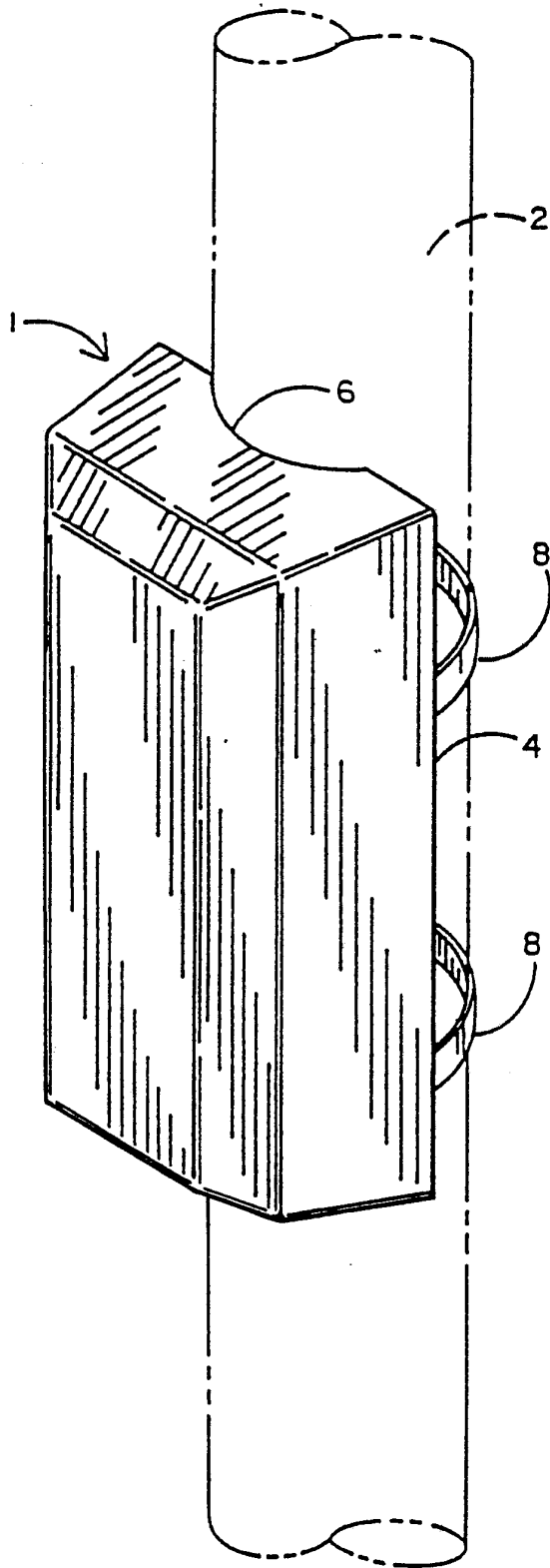


FIG. 6

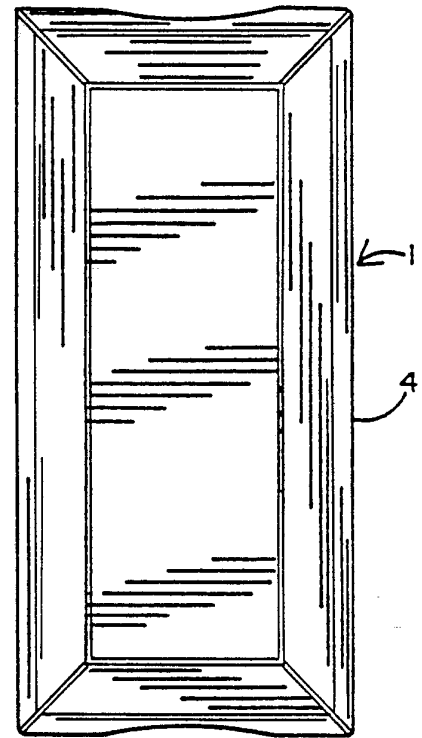


FIG. 7

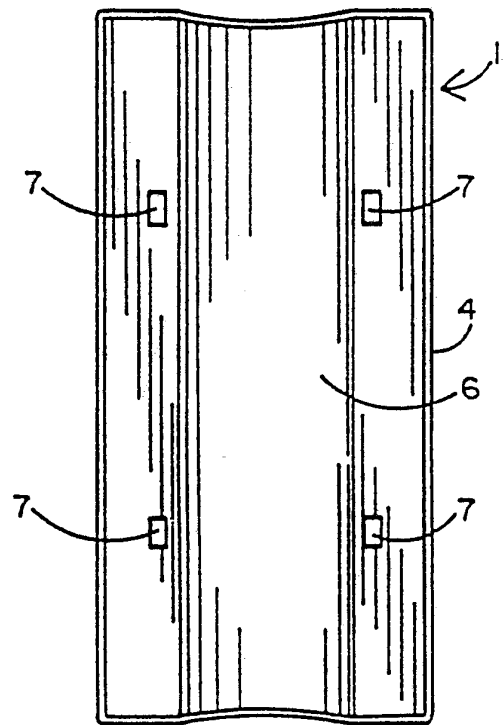


FIG. 8

- 4 / 9 -

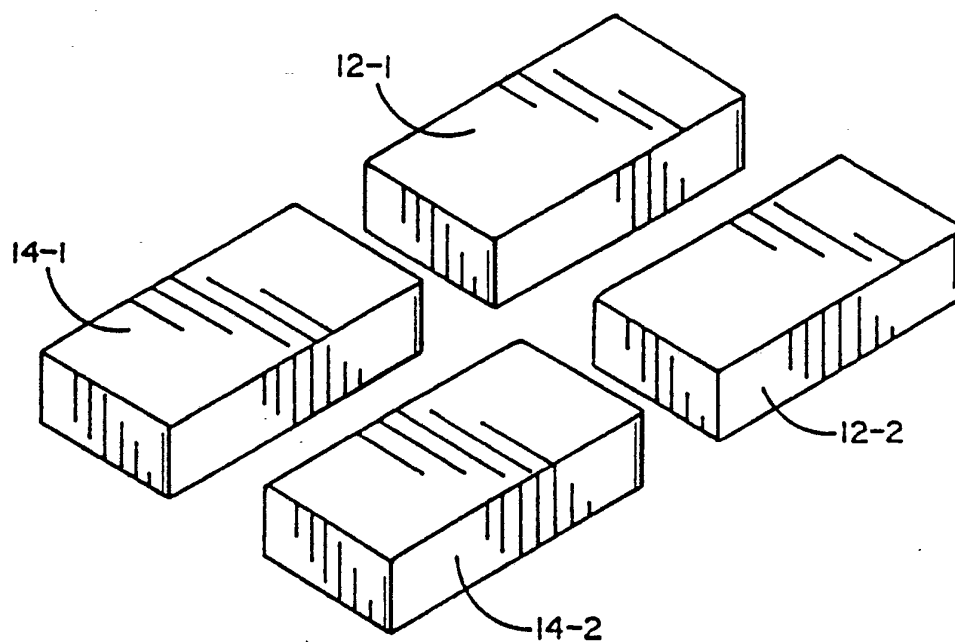


FIG. 9

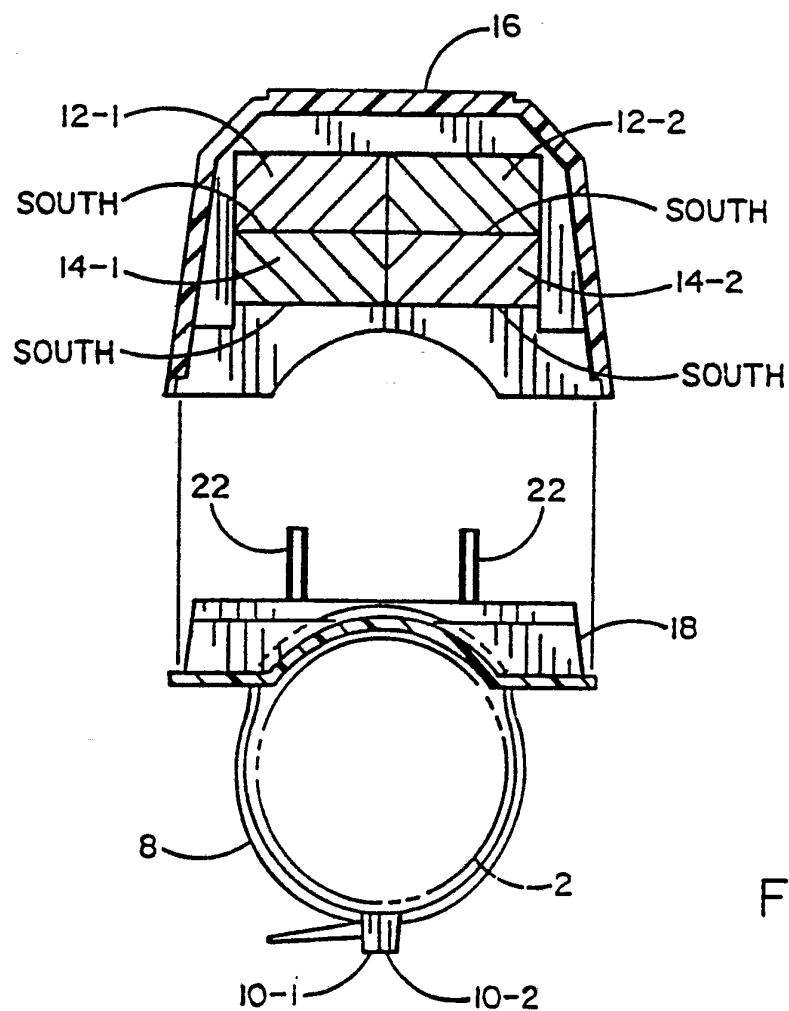


FIG. 10

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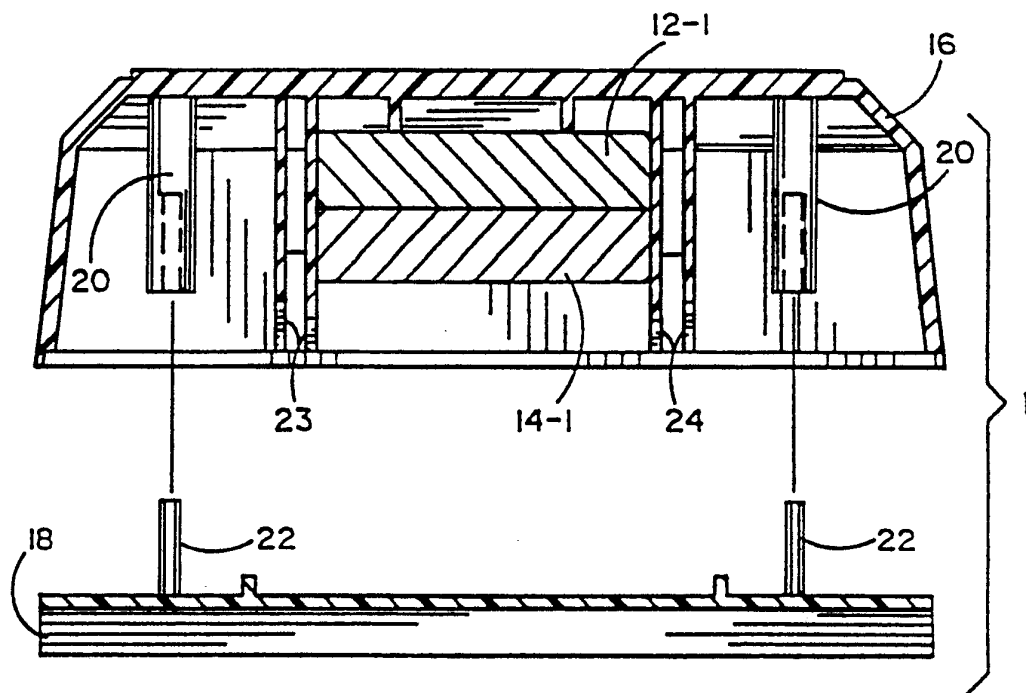


FIG. 11

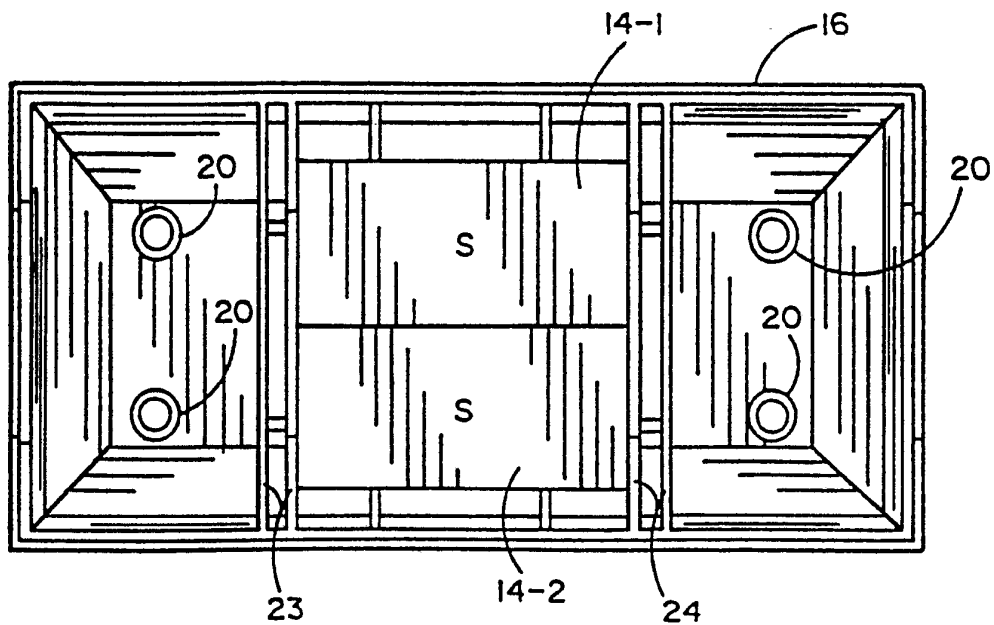
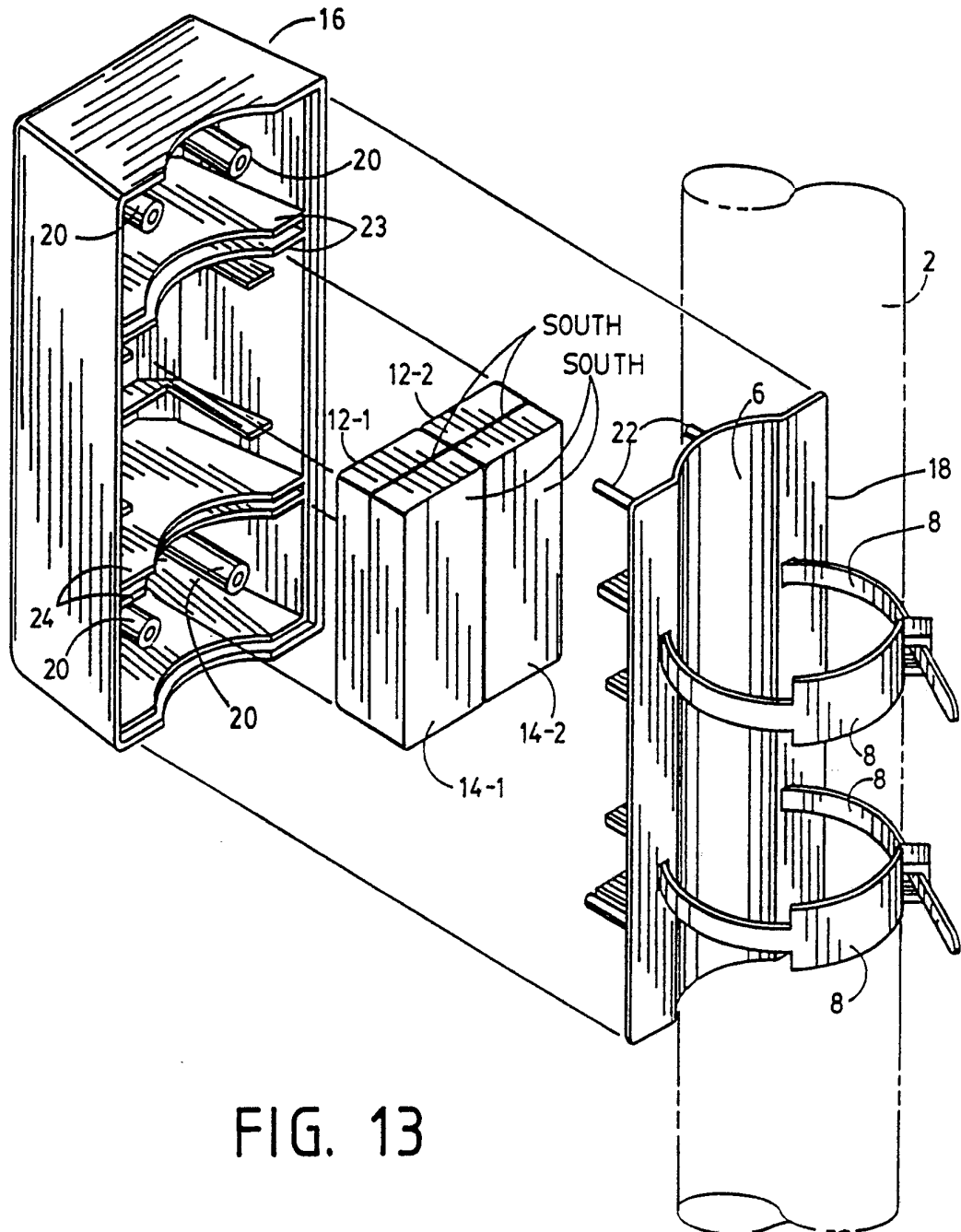


FIG. 12

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FIG.14

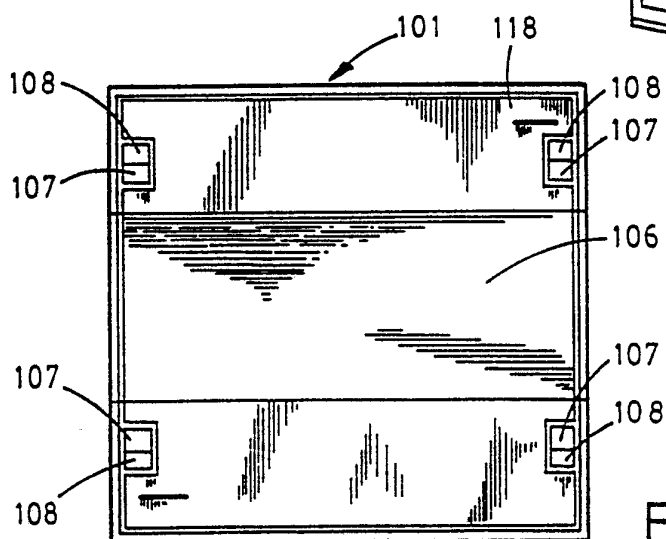
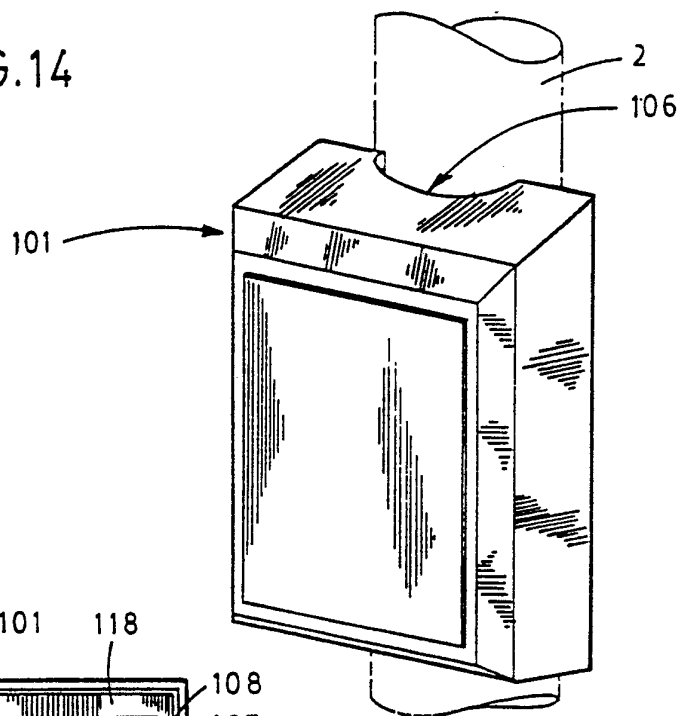


FIG.15

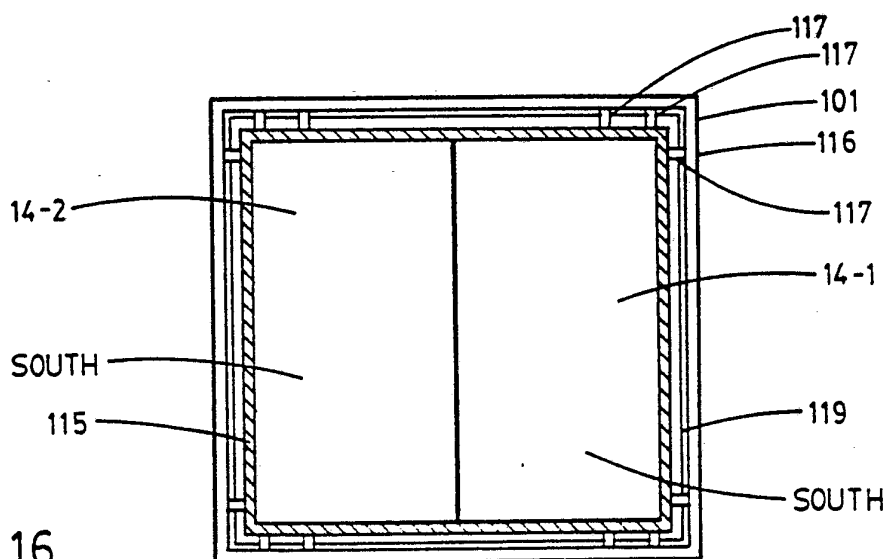


FIG.16

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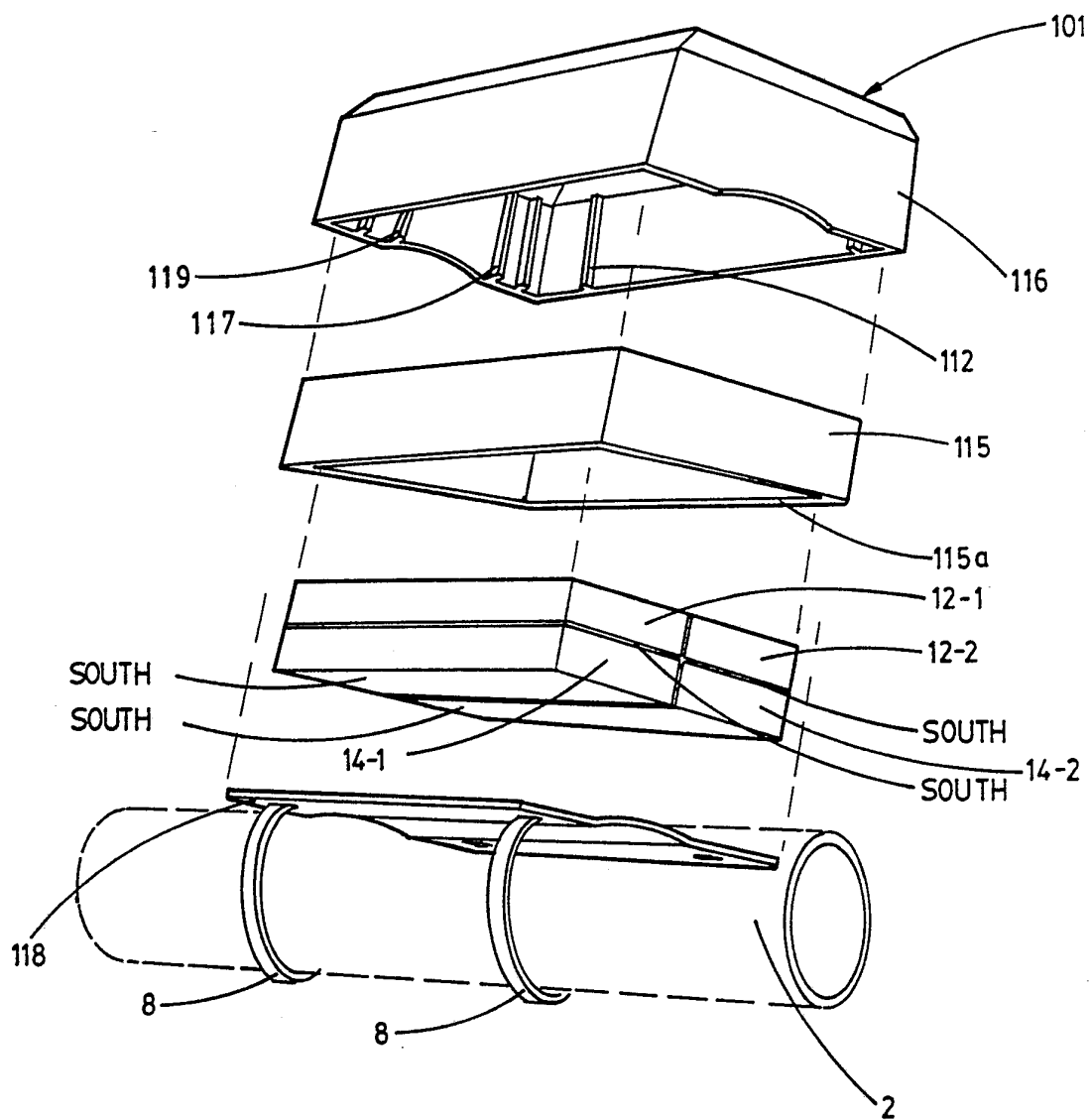


FIG. 17

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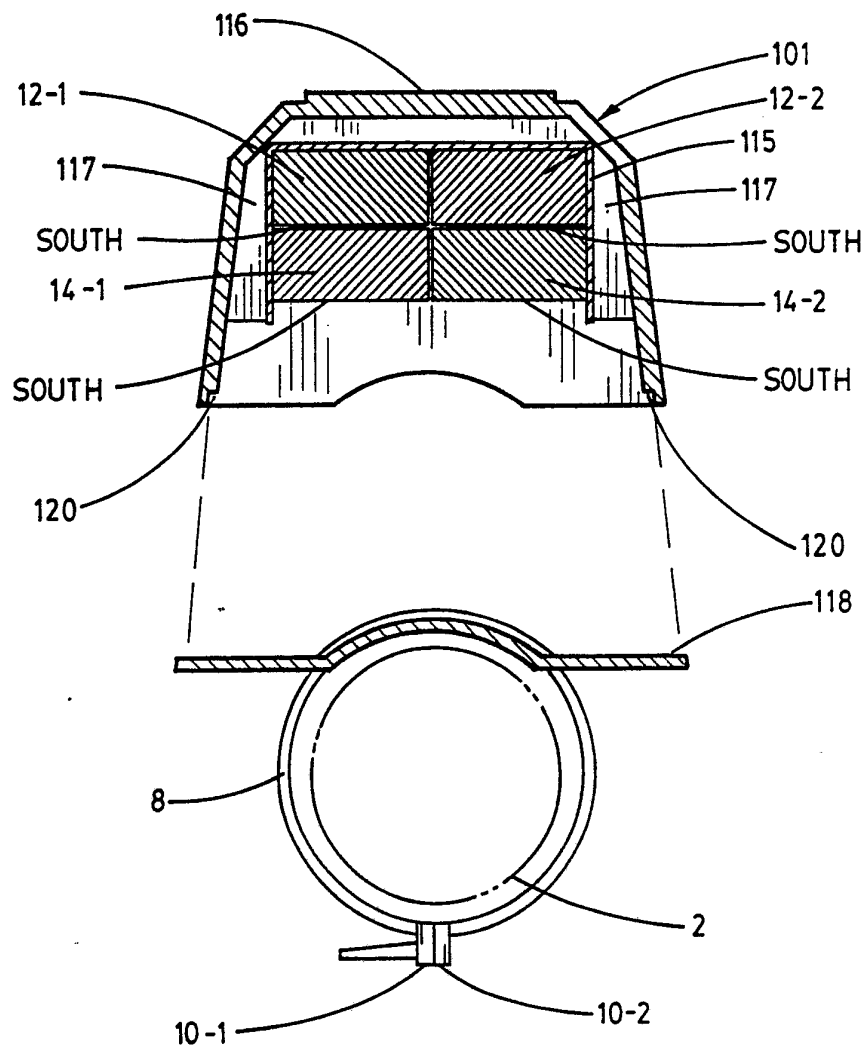
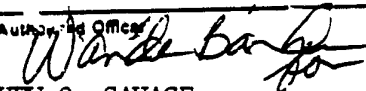


FIG. 18

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INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/09369

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC(5): C02F 1/48		
U.S. CL.: 210/695,222		
II. FIELDS SEARCHED		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
U.S.	210/222, 695; 55/100; 335/302, 306; 123/538	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched *		
III. DOCUMENTS CONSIDERED TO BE RELEVANT *		
Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages †	Relevant to Claim No. ‡
X	US,A, 4,486,729 (LEE) 04 DECEMBER 1984	1-3
Y	See figs. 2 and 4	4-5
Y	US,A, 3,980,562 (NILSSON) 14 SEPTEMBER 1976 See lines 19-21 of column 2	4,5
X	US,A, 4,888,113 (HOLCOMB) 19 DECEMBER 1989 See figs. 5-8 and lines 2-5 of column 4	13-19
X,P	US,A, 5,048,498 (CARDAN) 17 SEPTEMBER 1991 See figs. 2-3 and lines 49-65 of column 2	1-9,13,19
X,P	US,A, 5,063,368 (ETTEHADIEH) 05 NOVEMBER 1991 See fig. 8, lines 20-30 of column 3 and lines 34-45 of column 4	1-19
X,P	US,A, 5,030,344 (AMBROSE) 09 JULY 1991 See fig. 5 and lines 57-66 of column 1	1-9,13,19
* Special categories of cited documents: † "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed ** later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention x- document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step y- document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. Δ- document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
26 FEBRUARY 1992	27 APR 1992	
International Searching Authority	Signature of Authorizing Officer	
RO/US	 MATTHEW O. SAVAGE	