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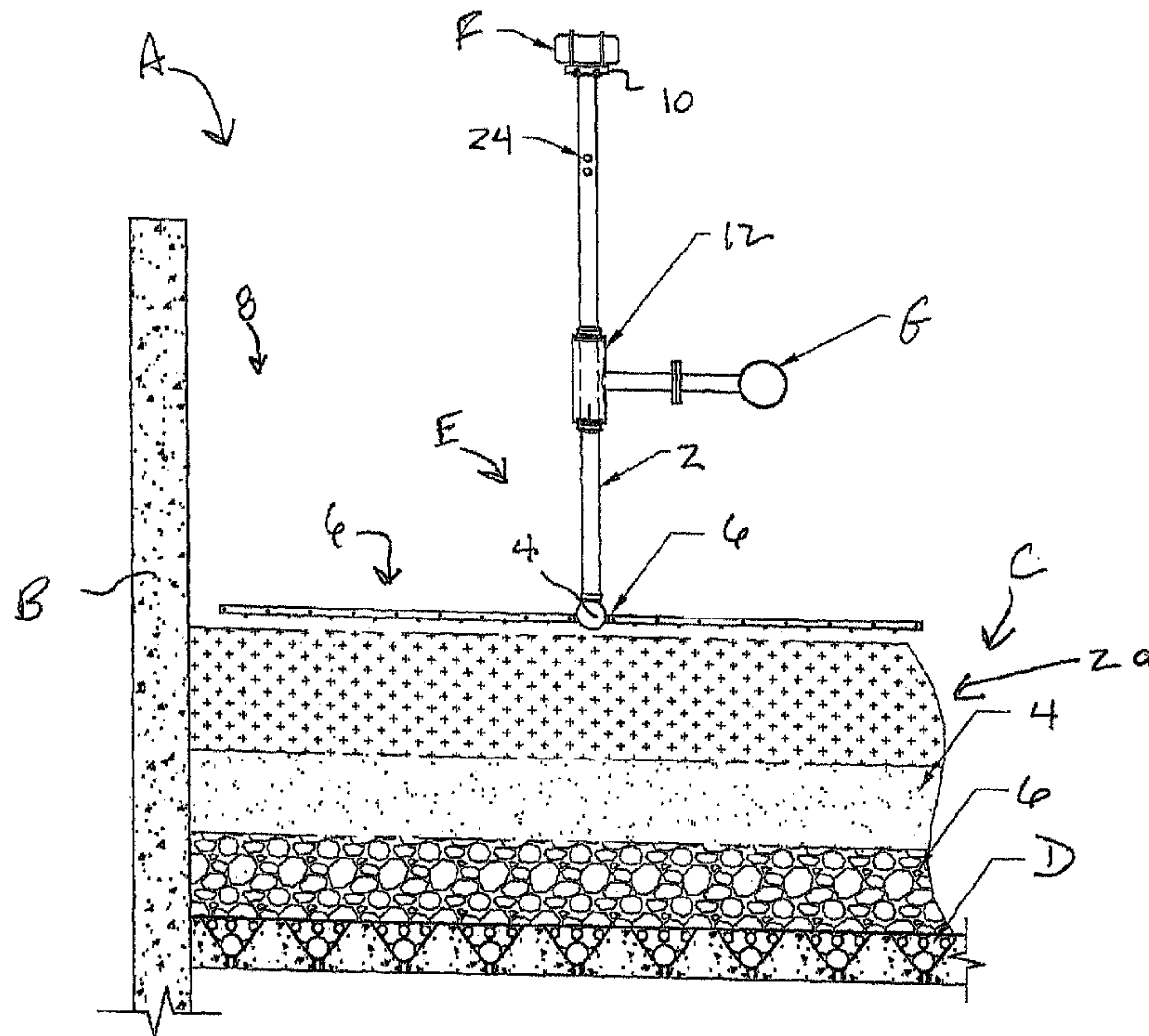
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(54) Titre : APPAREIL ET PROCEDE POUR ELIMINER LES IMPURETES DE L'EAU OU DES EAUX USEES

(54) Title: AN APPARATUS AND METHOD FOR REMOVING IMPURITIES FROM WATER OR WASTEWATER



(57) Abrégé/Abstract:

A filter for removing at least some impurities (e.g. foreign matter of any nature including a solid, a liquid or a gas) from water or wastewater. A vibrator operably associated with at least a portion of the filter for imparting a vibrational force to enhance any one or more of numerous aspects of the filtration process including: (i) installation of the filter and/or various components thereof; (ii) servicing of the filter and/or components thereof; and, (iii) operation of the filter during a filtration cycle and a cleaning cycle.

ABSTRACT OF THE DISCLOSURE

A filter for removing at least some impurities (e.g. foreign matter of any nature including a solid, a liquid or a gas) from water or wastewater. A vibrator operably associated with at least a portion of the filter for imparting a vibrational force to enhance any one or more of numerous aspects of the filtration process including: (i) installation of the filter and/or various components thereof; (ii) servicing of the filter and/or components thereof; and, (iii) operation of the filter during a filtration cycle and a cleaning cycle.

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TITLE

An Apparatus And Method For Removing Impurities From Water Or Wastewater

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FIELD OF THE INVENTION

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The present invention is directed to an apparatus and method for removing impurities from water and/or wastewater. More specifically, the present invention is directed to a filter having a filter compartment in which influent is passed to remove impurities from water or wastewater and a vibrator operably associated with the filter compartment for imparting a vibrational force to the filter compartment. Preferably, the vibrator can be used to enhance any one or more of numerous aspects of the filtration process including: (i) installation of the filter and/or various components thereof; (ii) servicing of the filter and/or components thereof; and, (iii) operation of the filter during a filtration cycle and a cleaning cycle.

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BACKGROUND OF THE INVENTION

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Various filters have been employed to remove at least some impurities from water or wastewater. Prior filters include but are not limited to upflow filters or upflow clarifiers, downflow filters, bi-flow filters and aerators. The present invention is directed to a filter of any suitable type and a vibrator operably associated therewith to enhance any one or more of numerous aspects of the filtration process including: (i) installation of the filter and/or various components thereof; (ii) servicing of the filter and/or components thereof; and, (iii) operation of

the filter during a filtration cycle and a cleaning cycle.

By way of example only and not limitation, filters having granular beds have employed air scour devices to improve cleaning of the granular filter bed. U.S. Patent Nos. 5,534,202 and 5,673,481 disclose, *inter alia*, a known method of inserting an air grid into a filter bed.

5 Specifically, these patents disclose fluidizing the filter bed to permit insertion of the air grid in the filter bed without removing filter media from the filter bed. While this was a significant improvement over prior systems, there are instances where fluidization of the filter bed is not practical and/or possible. One aspect of a preferred embodiment of the present invention is to use a vibrator to insert an air grid into a filter bed without fluidizing the filter bed and without
10 removing filter media from the filter bed. It is important to note that the present invention is not limited to the use of a vibrator operably associated with a filter to insert an air grid into a filter bed. Rather, the present invention includes operably associating a vibrator with a filter to enhance any one or more of numerous aspects of the filtration process including: (i) installation of the filter and/or various components thereof; (ii) servicing of the filter and/or components
15 thereof; and, (iii) operation of the filter during a filtration cycle and a cleaning cycle. This would include for example, using the vibrator to insert other elements into a filter bed without fluidizing the filter bed including but not limited to monitors for monitoring one or more conditions of a filter of the type disclosed in U.S. Patent Nos. 5,980,755 and 6,159,384. The present invention further includes but is not limited to operating a vibrator such that the vibrator
20 imparts a vibrational force to the filter during at least a portion of the filtration cycle to improve particle to particle contact so that particles to be filtered can agglomerate. The present invention further includes but is not limited to operating the vibrator during at least a portion of a cleaning

cycle to enhance agitation of the filtering element be it a granular bed, settling tubes, settling plates, membranes or other type of filter element to improve cleaning of the filter element.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the present invention is to provide a novel and unobvious apparatus and
5 method for removing impurities from water and/or wastewater.

Another object of a preferred embodiment of the present invention is to provide a suitable filter with a vibrator to enhance any one or more of numerous aspects of the filtration process including: (i) installation of the filter and/or various components thereof; (ii) servicing of the filter and/or components thereof; and, (iii) operation of the filter during a filtration cycle and a
10 cleaning cycle.

Still another object of a preferred embodiment of the present invention is to provide a filter with a vibrator for imparting a vibrational force to at least a portion of a filter bed so that a component of a filter can be readily inserted into at least a portion of the filter bed without fluidizing all or a portion of the filter bed and without removing filter media from the filter bed.

15 A further object of a preferred embodiment of the present invention is to provide a filter with a vibrator for imparting a vibrational force during at least a portion of the filtration cycle to improve the filtration efficiency of the filtering element.

Yet another object of a preferred embodiment of the present invention is to provide a filter with a vibrator for imparting a vibrational force during at least a portion of the cleaning
20 cycle to enhance cleaning of the filtering element

Yet a further object of a preferred embodiment of the present invention is to provide a filter with an adapter to permit height adjustment of a filter component including but not limited

to a fluid conduit.

Still a further object of a preferred embodiment of the present invention is to provide a filter with a vibrator for imparting a vibrational force to at least a portion of a filter bed so that a component of a filter can be readily inserted into at least a portion of the filter bed without passing any fluid through the filter bed and without removing filter media from the filter bed.

It must be understood that no one embodiment of the present invention need include all of the aforementioned objects of the present invention. Rather, a given embodiment may include one or none of the aforementioned objects. Accordingly, these objects are not to be used to limit the scope of the claims of the present invention.

In summary, one preferred embodiment of the present invention is directed to an apparatus for filtering water or wastewater including a filter having a filter compartment for removing impurities from influent and a vibrator operably associated with the filter compartment for imparting a vibrational force to at least a portion of the filter compartment.

Another preferred embodiment of the present invention is directed to apparatus for filtering water or wastewater including a filter having a filter compartment including a filter bed having at least one layer of filter media for removing impurities from influent. The apparatus includes at least one fluid conduit for directing a fluid through the filter bed. At least a portion of the at least one fluid conduit is inserted in the filter bed. A vibrator is operably associated with the filter compartment for imparting a vibrational force to at least a portion of the filter bed to permit a portion of the at least one fluid conduit to be inserted into or removed from the filter bed.

A further embodiment of the present invention is directed to an apparatus for filtering water or wastewater including a filter having a filter compartment in which at least some impurities are removed from influent and an air grid disposed in the filter compartment for directing air through at least a portion of the filter compartment. The air grid includes a drop pipe, at least one header and at least one lateral. An adapter is operably associated with the drop pipe for permitting vertical adjustment of the drop pipe. The adapter forms an air chamber along a portion of the drop pipe between a first end of the drop pipe and a second end of the drop pipe. The drop pipe has at least one orifice in communication with the air chamber such that air from the air chamber can pass into the drop pipe.

Still another embodiment of the present invention is directed to a method of filtering water or wastewater including the steps of: (a) providing a filter having a filter compartment in which at least some impurities from influent are removed; (b) providing at least one vibrator; (c) operably associating the at least one vibrator with at least a portion of the filter; and, (d) transmitting a vibrational force to at least a portion of the filter.

Still a further embodiment of the present invention is directed to a method of filtering water or wastewater including the steps of: (a) providing a filter, the filter including a filter bed in which at least some impurities from influent are removed and a conduit for directing a fluid through at least a portion of the filter bed; (b) providing at least one vibrator; (c) operably associating the at least one vibrator with at least a portion of the filter bed; (d) providing a component at least a portion of which is to be partially inserted in the filter bed; (d) transmitting a vibrational force to at least a portion of the filter bed while directing fluid through at least a portion of the filter bed at subfluidization velocity; and, (e) inserting at least a portion of the

component into the filter bed during step (d).

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a fragmentary cross-sectional view of a preferred embodiment of the present invention depicting an air grid prior into installation into a filter bed.

FIGURE 2 is a fragmentary cross-sectional view of a preferred embodiment of the present invention depicting an air grid being inserted into a filter bed.

FIGURE 3 is a fragmentary cross-sectional view of a preferred embodiment of the present invention depicting an air grid subsequent to installation into a filter bed.

FIGURE 4 is an elevational view of an air grid formed in accordance with a preferred embodiment of the present invention with a vibrator removably attached thereto.

FIGURE 5 is a plan view of an adapter formed in accordance with a preferred embodiment of the present invention.

FIGURE 6 is an elevation view of an adapter formed in accordance with a preferred embodiment of the present invention.

FIGURE 7 is an right end view of an adapter formed in accordance with a preferred embodiment of the present invention.

FIGURE 8 is a fragmentary view of a drop pipe formed in accordance with a preferred embodiment of the present invention.

FIGURE 9 is a plan view of a drop pipe formed in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

The preferred forms of the invention will now be described with reference to **FIGS. 1-9**.

The appended claims are not limited to the preferred forms and no term and/or phrase used

5 herein is to be given a meaning other than its ordinary meaning unless it is expressly stated
otherwise. Fluidization as used herein means at least 20 percent expansion of a filter bed. Sub-
fluidization velocity of a fluid means a velocity of a fluid in which at least a portion of the filter
bed is expanded less than 20 percent.

FIGS. 1 THROUGH 9

10 Referring to figures 1 to 9, a filter system **A** employing a preferred form of the invention is
illustrated in one of many possible configurations. Filter **A** includes a tank **B**, a filter bed **C**, an
underdrain **D**, an air grid system **E**, a vibrator **F** and an air supply source **G**. While filter **A** as shown
in Figures 1 to 3 is a downflow filter (i.e., influent is passed downwardly through the filter bed **C**
during filtration), any filter can be used including but not limited to an upflow filter, an upflow
15 clarifier and a bi-flow filter. As used herein, the term filter refers to any device that removes at least
some impurities (e.g. foreign matter of any nature including a solid, a liquid or a gas) from water or
wastewater. Tank **B** can be formed from concrete, metal or other suitable material. Further, tank **B**
can be rectangular, circular or any other suitable shape.

Filter bed **C**, as shown in Figures 1 to 3, includes a layer of anthracite **2a** on top of a layer of
20 sand **4** supported by a layer of gravel **6**. It will be readily appreciated that any suitable filter bed may
be used including a single layer filter bed. Further, while a gravel layer **6** is depicted as supporting
the layers of filter media **2a** and **4** above a conventional wheeler bottom type underdrain **D**, the

underdrain **D** may be any conventional type including an underdrain formed from a plurality of laterals having a porous plate connected thereto obviating the need for a gravel layer. Further, while the filter element is depicted as a granular filter bed, vibrator **F** can be used with any suitable filter element to enhance filtration or cleaning of the filter element. For example, the filter element can be settling plates, settling tubes or membranes.

The air grid system **E** includes a substantially vertically extending drop pipe **2**, a substantially horizontally extending air header **4** and a plurality of substantially horizontally extending laterals **6**. The air grid system can include multiple grids in filter compartment **8**. The air grid system **E** can be of the type disclosed in U.S. Patent Nos. 5,534,202 and 5,673,481. However, the present invention is not limited to the air grid disclosed in U.S. Patent Nos. 5,534,202 and 5,673,481. Rather, any suitable air grid may be used. Further, the air grid may be omitted. For example, vibrator **F** may be used to insert other components into a filter bed including but not limited to a monitor for monitoring at least one condition of the filter. The monitors disclosed in U.S. Patent Nos. 5,980,755 and 6,159,384 are one type of monitor that can be inserted into filter bed **C** using vibrator **F**.

In the preferred form of the present invention, the vibrator **F** is removably connected to a plate **10** disposed at an upper portion of drop pipe **2** to impart a vibrational force through the drop pipe **2**, header **4** and the plurality of laterals **6**. Plate **10** is connected to the upper end of drop pipe **2** to create a sealed upper end. A vibrational force will be imparted to the filter bed **C** as the laterals **6**, header **4** and drop pipe **2** come into contact with filter bed **C**. Preferably, the vibrator **F** has a frequency of between 30 to 60 HZ and exerts between 400 lbs to 1,000 lbs of force to allow the air grid system **E** to be inserted into filter bed **C** as depicted in Figure 3. One suitable vibrator is the

Martin Vibration Systems Model CDH 2.5 vibrator. However, the present invention is not limited to such a vibrator. Rather, any suitable vibrator may be used.

Most preferably, the frequency of vibrator **F** matches the resonant frequency of the air grid system **E**. It should be noted that the resonant frequency of the air grid system **E** will vary with the configuration of the air grid, the media profile, water depth in the filter compartment **10** and other well known factors.

While the air grid system **E** is depicted in Figure 3 as being installed directly above gravel layer **6**, the final position of air grid system **E** in the granular media may be varied as desired.

In the most preferred form of the present invention, the air grid system **E** is at least partially inserted into the filter bed **C** by imparting a vibrational force to filter bed **C** without passing any fluid through the filter bed **C** and without removing media from filter bed **C**. This is desirable especially in those instances for example during initial installation of a filter system where a fluid source may not be available. In another preferred form of the present invention, the air grid system **E** or other component is at least partially inserted in filter bed **C** by imparting a vibrational force to filter bed **C** while simultaneously directing a fluid through the filter bed where the velocity of the fluid is sub-fluidization, i.e., where at least a portion of the bed does not expand more than 20 percent. This is desirable as the vibrational force necessary to insert the component in the filter bed **C** can be significantly reduced. Further, the sub-fluidization velocity feature may allow for considerable savings in equipment costs including costs of pumps and related components. Moreover, the application of a vibrational force in combination with the sub-fluidization velocity to the filter bed **C** allows for insertion of a component in a filter bed **C** without removing filter media in those instances where it is impractical or impossible to fluidize the filter bed. It should be noted that the fluid used

with the vibrational force may be a liquid or a gas or a combination thereof. Further, the fluid may be influent, filtered water or air. Preferably, the fluid is passed upwardly through filter bed C when inserting air grid system E or other component into filter bed C.

While vibrator F is located on the top of drop pipe 2, the vibrator may be located in any
5 suitable position including attached to or mounted on a wall of the filter compartment 8, mounted on or attached to header 4 and mounted on or attached to one or more of laterals 6. Alternatively, vibrator F could be mounted on another element in contact with filter bed C.

Air grid system E may be removed from filter bed C for servicing or replacement by following the same procedure for inserting air grid system E into filter bed C.

10 Preferably, even after air grid system E is inserted into filter bed C, vibrator F is also operated during at least a portion of the filtration cycle to enhance particle to particle contact resulting in the agglomeration of impurities such that the impurities are easily trapped in the filter bed or other filter element. Specifically, the vibrational force will be transmitted to the influent passing through the filter compartment 8 enhancing particle to particle collision resulting in
15 agglomeration of impurities. When vibrator F is not in use, it can be readily removed from drop pipe 2 and filter compartment 8.

Preferably, even after air grid system E is inserted into filter bed C, vibrator F is also operated during at least a portion of a cleaning cycle of filter bed C or other filter element to enhance agitation to aid in dislodging the impurities from filter bed C or other filter element. For example,
20 vibrator F may be used while a liquid and/or air are passed upwardly through filter bed C. Further, operation of the vibrator F to impart a vibrational force to filter bed C could be a separate cleaning step before or after passing a fluid through filter bed C.

In the most preferred form of the present invention, drop pipe 2 is provided with an adapter 12 for permitting vertical adjustment of drop pipe 2. Adapter 12 is particularly advantageous as it allows one to readily compensate for a drop pipe or other component that is inadvertently sized incorrectly (e.g., too short or too long) without any field alteration to the size of the drop pipe 2. It should be noted that adapter 12 is optional.

Referring to Figures 5 to 7, adapter 12 includes a hollow tubular member 14 having a hollow cavity 16 extending therethrough to receive drop pipe 2. Referring to Figure 4, adapter 12 includes an upper seal 18 and a lower seal 20 to form an air chamber surrounding drop pipe 2. Preferably, as seen in Figure 8, drop pipe 2 includes orifices 22 and 24 to permit air in the surrounding air chamber to pass through drop pipe 2, header 4 and laterals 6 into filter bed C. Adapter 12 further includes a conduit 26 in communication with cavity 16 at one end and air supply source G at the other end to convey air from the supply source G to cavity 16. A plate 28 is preferably formed at one end of conduit 26 to facilitate connection with a mating element of air supply source G.

While this invention has been described as having a preferred design, it is understood that the preferred design can be further modified or adapted following in general the principles of the invention and including but not limited to such departures from the present invention as come within the known or customary practice in the art to which the invention pertains. The claims are not limited to the preferred embodiment and have been written to preclude such a narrow construction using the principles of claim differentiation.

I CLAIM:

1. An apparatus comprising:

(a) a filter having a filter bed for removing at least some impurities from influent;

(b) an air grid disposed in said filter bed for directing air through at least a portion of said filter bed, said air grid including a drop pipe having at least one orifice, at least one header and at least one lateral;

(c) an air source; and,

(d) a hollow tubular member for permitting vertical adjustment of said drop pipe, said hollow tubular member being open at each end and sized so that a portion of said drop pipe is allowed to slide through said hollow tubular member, said hollow tubular member being connected to said air source, said hollow tubular member forming a cavity around said drop pipe and said at least one orifice being in communication with said cavity so that pressurized air supplied to said cavity from said air source is allowed to pass into said drop pipe.

2. The apparatus as set forth in claim 1, wherein:

(a) a first seal and a second seal are connected to opposite ends of said hollow tubular member to seal said cavity, said orifice of said drop pipe is positioned between said first seal and said second seal, said hollow tubular member is connected to a supply conduit for supplying air to said drop pipe via said sealed cavity, and said supply conduit extends horizontally and is disposed between said first seal and said second seal.

3. The apparatus as set forth in claim 2, further including:

(a) a circular plate being attached to an end of said supply conduit removed from said hollow tubular member for connecting said supply conduit to said air source.

4. The apparatus as set forth in claim 2, wherein:

(a) said first seal is connected to an upper end of said hollow tubular member and said second seal is connected to a lower end of said hollow tubular member and at least a portion of said drop pipe extends above said hollow tubular member and said first seal when said air grid is installed in an operating position.

5. The apparatus as set forth in claim 4, wherein:

(a) said first seal extends above said upper end of said hollow tubular member and said second seal extends below said lower end of said hollow tubular member.

6. The apparatus as set forth in claim 1, wherein:

(a) at least a portion of said drop pipe extends above said hollow tubular member when said air grid is installed in an operating position.

7. An apparatus comprising:

- (a) a filter having a filter bed for removing at least some impurities from influent;
- (b) an air grid disposed in said filter bed for directing air through at least a portion of said filter bed, said air grid including a drop pipe having at least one orifice, at least one header and at least one lateral;
- (c) an air source; and,
- (d) a hollow tubular member for permitting vertical adjustment of said drop pipe during installation by allowing a portion of said drop pipe to slide through said hollow tubular member at some point during installation of said drop pipe, said hollow tubular member being connected to said air source, said hollow tubular member forming a cavity around said drop pipe and said at least one orifice being in communication with said cavity so that pressurized air supplied to said

cavity from said air source is allowed to pass into said drop pipe, and said hollow tubular member is connected to a supply conduit for supplying air to said drop pipe wherein a position of said supply conduit can be readily varied by rotating said hollow tubular member about said drop pipe.

8. The apparatus as set forth in claim 7, wherein:

(a) a first seal and a second seal are connected to opposite ends of said hollow tubular member to seal said cavity, said orifice of said drop pipe is positioned between said first seal and said second seal, said supply conduit being configured to direct air into said drop pipe via said sealed cavity, and said supply conduit extends horizontally and is disposed between said first seal and said second seal.

9. The apparatus as set forth in claim 8, further including:

(a) a circular plate attached to an end of said supply conduit removed from said hollow tubular member for connecting said supply conduit to said air source.

10. The apparatus as set forth in claim 9, wherein:

(a) said first seal is connected to an upper end of said hollow tubular member and said second seal is connected to a lower end of said hollow tubular member and at least a portion of said drop pipe extends above said hollow tubular member and said first seal when said air grid is installed in an operating position.

11. The apparatus as set forth in claim 10, wherein:

(a) said first seal extends above said upper end of said hollow tubular member and said second seal extends below said lower end of said hollow tubular member.

12. The apparatus as set forth in claim 7, wherein:

(a) at least a portion of said drop pipe extends above said hollow tubular member when said air grid is installed in an operating position.

13. An apparatus comprising:

(a) a filter having a filter bed for removing at least some impurities from influent;

(b) an air grid disposed in said filter bed for directing air through at least a portion of said filter bed, said air grid including a drop pipe having at least one orifice, at least one header and a plurality of laterals;

(c) an air source; and,

(d) a hollow cylindrical member for permitting vertical adjustment of said drop pipe by allowing a portion of said drop pipe to slide through said hollow cylindrical member, said hollow cylindrical member being connected to said air source, said hollow cylindrical member forming a cavity around said drop pipe and said at least one orifice being in communication with said cavity so that pressurized air supplied to said cavity from said air source is allowed to pass into said drop pipe.

14. The apparatus as set forth in claim 13, wherein:

(a) said hollow cylindrical member is connected to a supply conduit for supplying air to said drop pipe and a circular plate is attached to an end of said supply conduit removed from said hollow cylindrical member for connecting said supply conduit to said air source.

15. The apparatus as set forth in claim 14, further including:

(a) a first seal being connected to an upper end of said hollow cylindrical member and a second seal being connected to a lower end of said hollow cylindrical member and at least a portion of said drop pipe extends above said hollow cylindrical member and said first seal when

said air grid is installed in an operating position.

16. The apparatus as set forth in claim 15, wherein:

(a) said first seal extends above said upper end of said hollow cylindrical member and said second seal extends below said lower end of said hollow cylindrical member.

17. The apparatus as set forth in claim 13, wherein:

(a) at least a portion of said drop pipe extends above said hollow cylindrical member when said air grid is installed in an operating position.

18. An apparatus for filtering water or wastewater, said apparatus comprising:

(a) a filter having a filter compartment in which at least some impurities are removed from influent;

(b) an air grid disposed in said filter compartment for directing air through at least a portion of said filter compartment, said air grid including a drop pipe, at least one header and at least one lateral; and,

(c) an adapter operably associated with said drop pipe for permitting vertical adjustment of said drop pipe, said adapter forming an air chamber along a portion of said drop pipe between a first end of said drop pipe and a second end of said drop pipe, said drop pipe having at least one orifice in communication with said air chamber such that air from said air chamber can pass into said drop pipe.

19. An apparatus as set forth in Claim 18, wherein:

(a) said adapter includes a hollow sleeve, a first seal and a second seal for forming said air chamber, said air chamber surrounding a portion of said drop pipe, said orifice of said drop pipe is positioned between said first seal and said second seal, said adapter further including a

supply conduit for supplying air to said drop pipe via said air chamber.

20. A method for washing a filter for filtering water or wastewater, said method including the steps of:

(a) providing a filter having a filter bed in which at least some impurities are removed from influent;

(b) positioning an air grid in said filter bed, said air grid including a drop pipe, at least one header and at least one lateral;

(c) providing an adapter for permitting vertical adjustment of said drop pipe, said adapter forming an air chamber along a portion of said drop pipe between a first end of said drop pipe and a second end of said drop pipe, said drop pipe having at least one orifice in communication with said air chamber such that air from said air chamber passes into said drop pipe and travels downwardly through said drop pipe during washing of said filter bed; and, (d) directing air through said air grid into said filter bed to remove impurities trapped in said filter bed during a filtration cycle.

21. The method of claim 20, wherein the directing air step includes directing air into said drop pipe from the air chamber of said adapter.

22. The method of claim 21, wherein the directing air step further includes directing air downwardly through said drop pipe into and through said at least one lateral and out the at least one lateral into the filter bed.

23. The method of claim 20, wherein during the directing air step, said adapter does not move in a vertical direction relative to said drop pipe.

24. The method of claim 20, further including the step of moving said drop pipe in a

vertical direction relative to said adapter prior to the directing air step.

25. The method of claim 20, wherein said filter bed includes at least one layer of gravel and at least one layer of filter media, the at least one lateral is disposed above said at least one layer of gravel and in said at least one layer of filter media.

26. A method for washing a filter for filtering water or wastewater, said method including the steps of:

(a) providing a filter having a filter bed in which at least some impurities are removed from influent;

(b) positioning an air grid in said filter bed, said air grid including a drop pipe, at least one header and at least one lateral, said drop pipe having a sealed upper end and an open lower end;

(c) providing an adapter for permitting vertical adjustment of said drop pipe, said adapter forming an air chamber along a portion of said drop pipe between said sealed upper end of said drop pipe and said open lower end of said drop pipe, said drop pipe having at least one orifice in communication with said air chamber such that air from said air chamber passes into said drop pipe and travels downwardly through said drop pipe during washing of said filter bed; and,

(d) directing air through said air grid into said filter bed to remove impurities trapped in said filter bed during a filtration cycle.

27. The method of claim 26, wherein the directing air step includes directing air into said drop pipe from the air chamber of said adapter.

28. The method of claim 27, wherein the directing air step further includes directing air downwardly through said drop pipe into and through said at least one lateral and out the at least

one lateral into the filter bed.

29. The method of claim 26, wherein during the directing air step, said adapter does not move in a vertical direction relative to said drop pipe.

30. The method of claim 26, further including the step of moving said drop pipe in a vertical direction relative to said adapter prior to the air directing step.

31. The method of claim 26 wherein said filter bed includes at least one layer of gravel and at least one layer of filter media, the at least one lateral is disposed above said at least one layer of gravel and in said at least one layer of filter media.

Figure 1

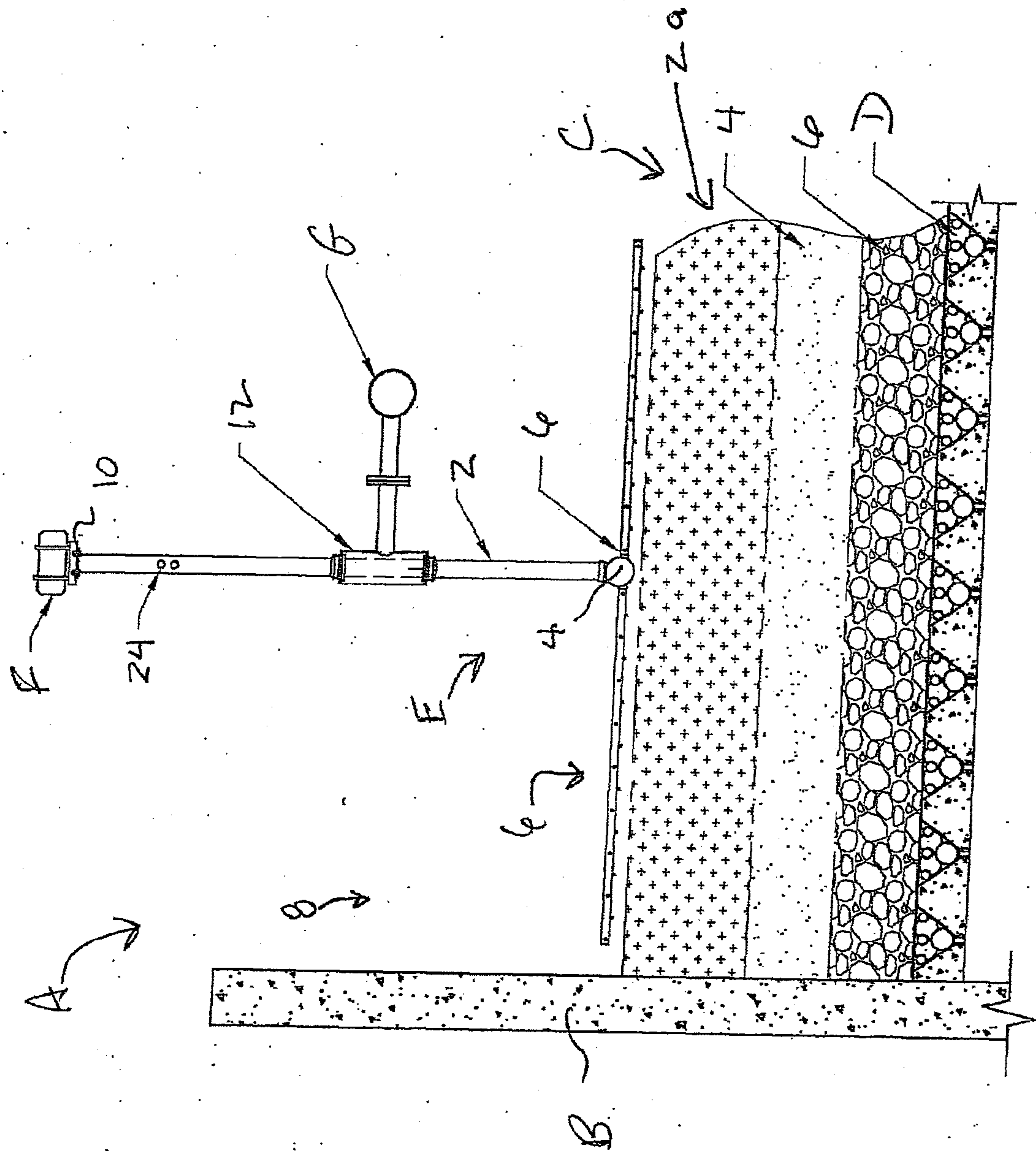


Figure 2

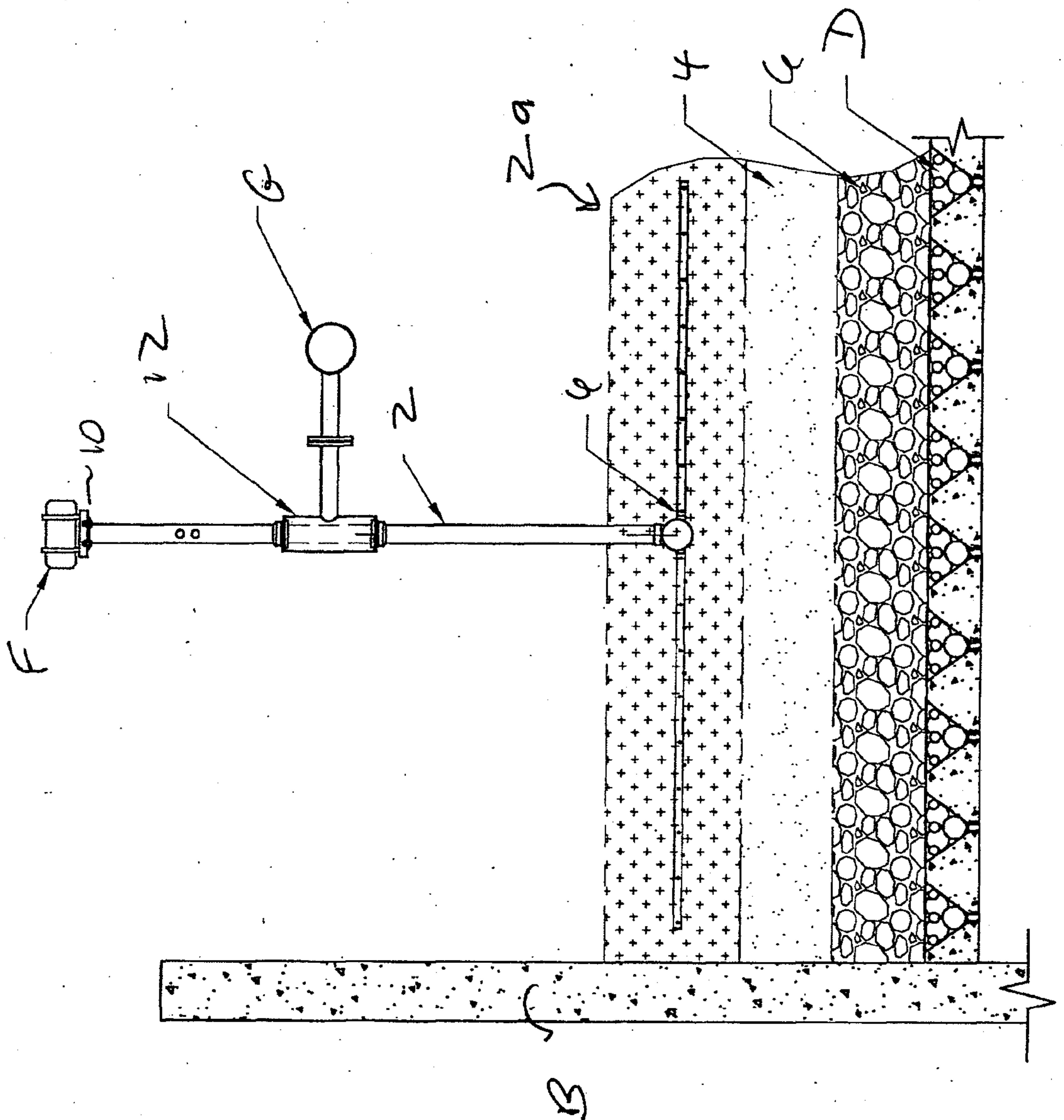


Figure 3

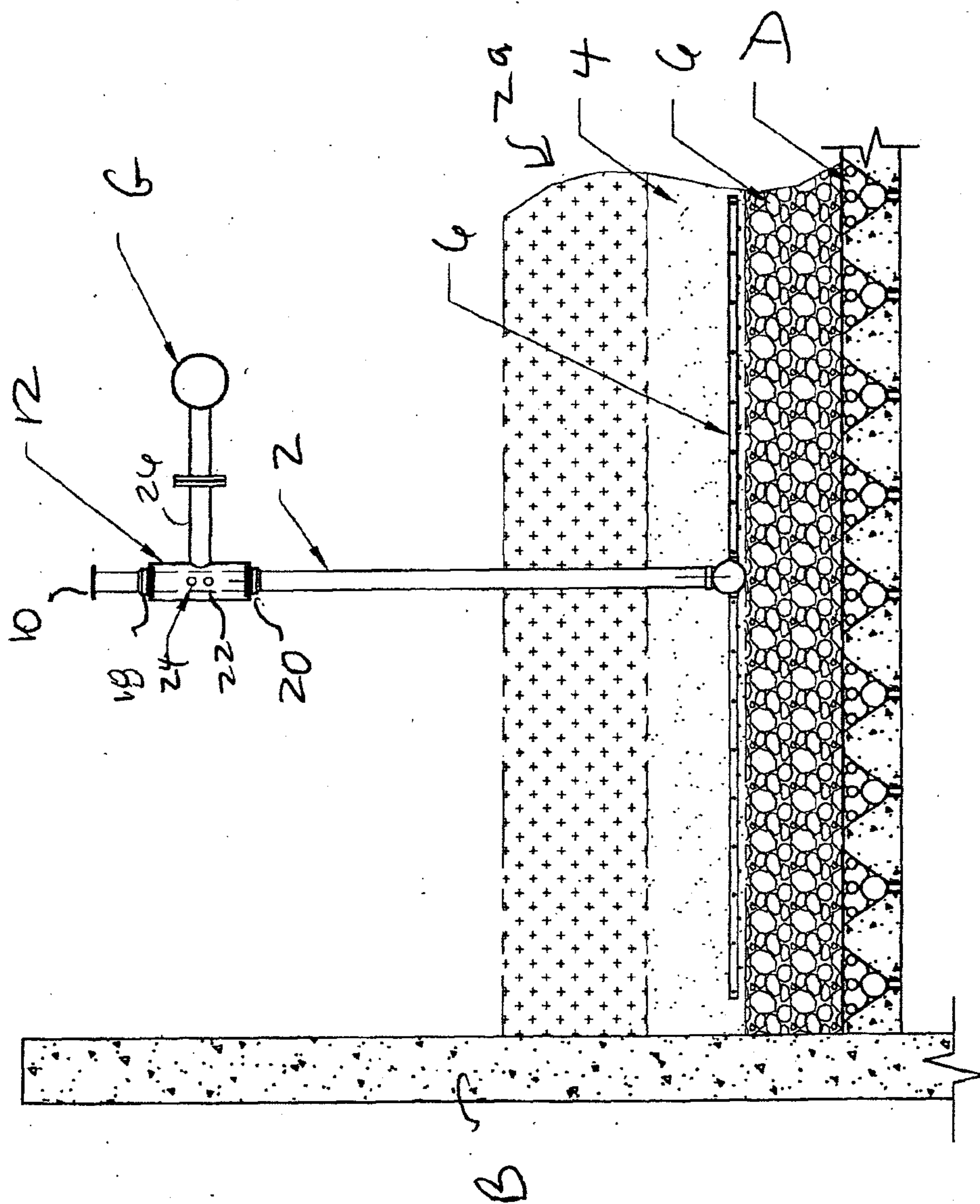
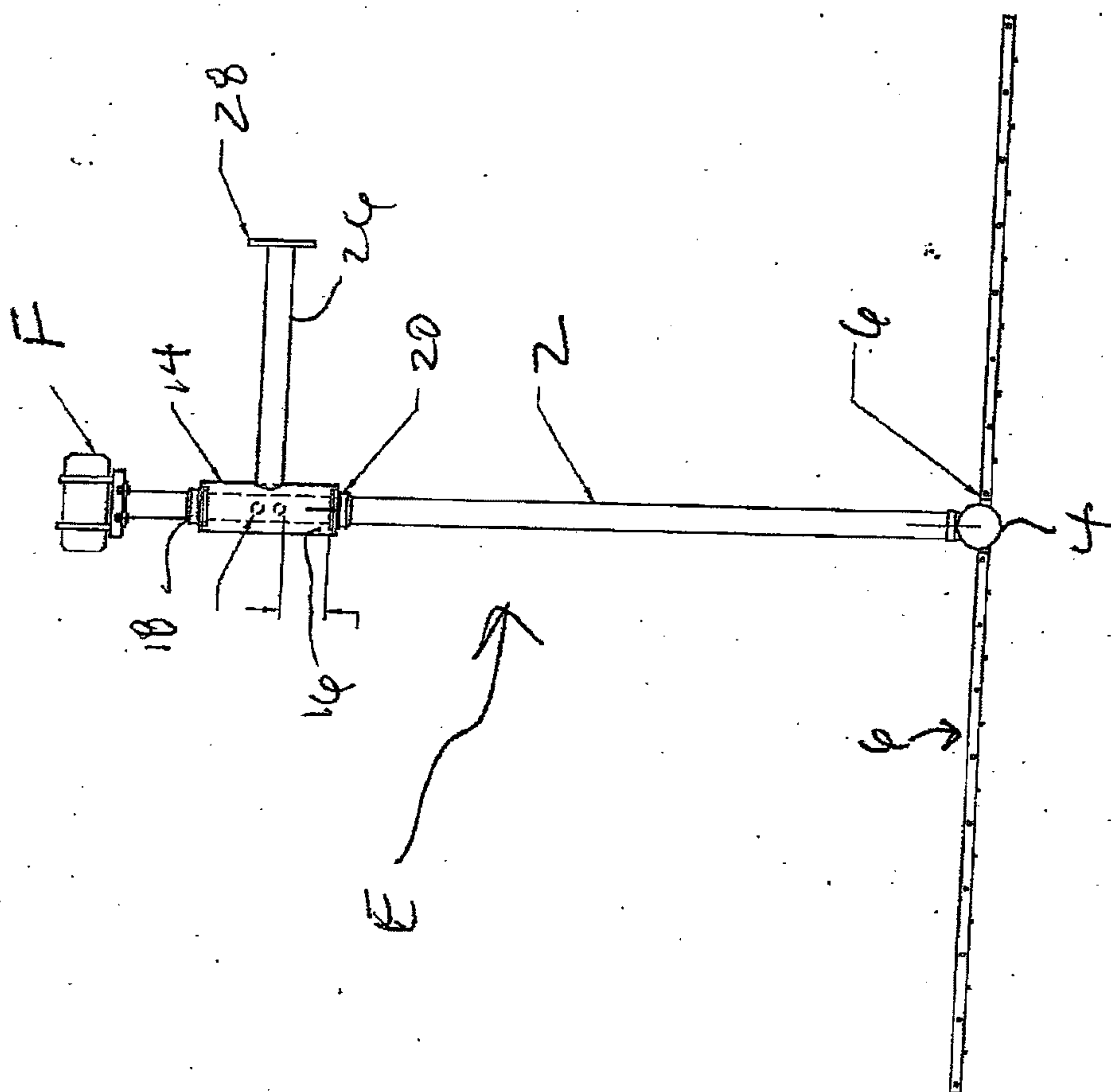


Figure 4



525 F.

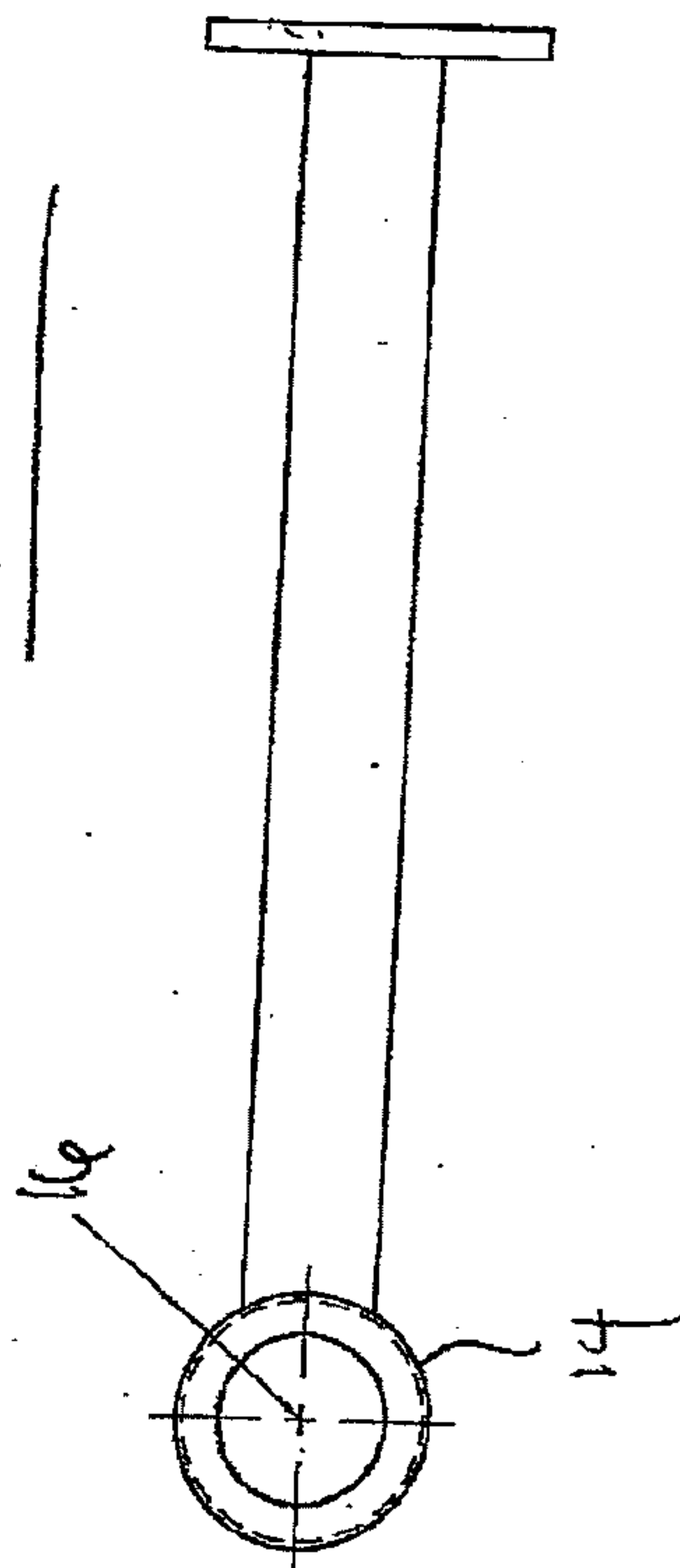


Figure 4

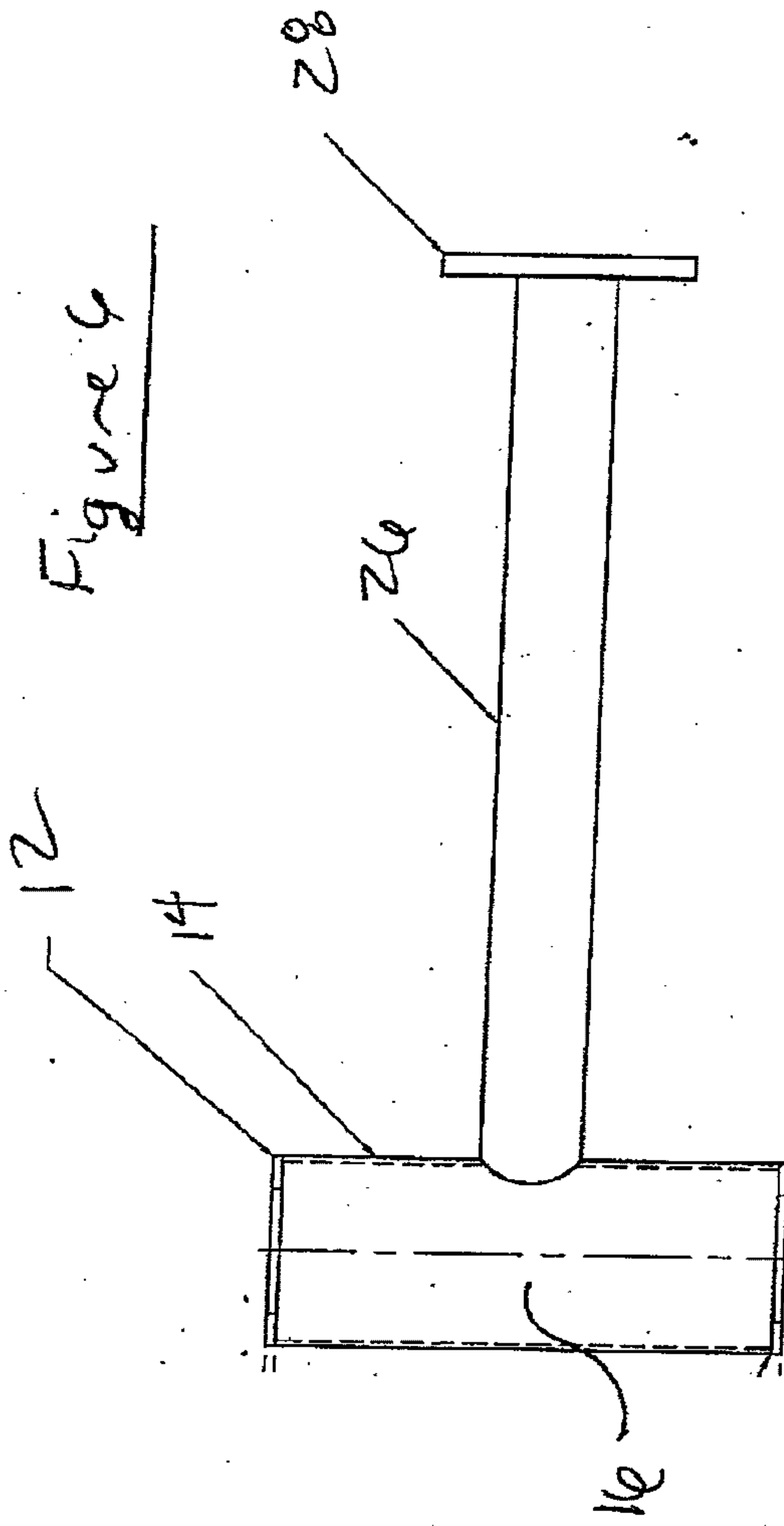


Figure 7

