Feb. 14, 1967 D. MASTINI 3,303,649

HYDRAULIC SYSTEM HAVING A NATURAL DIFFERENCE OF LEVEL, TO BE USED AS DRIVING POWER OR FOR OBTAINING OTHER BENEFITS

Filed Sept. 8, 1966

FIG. 1

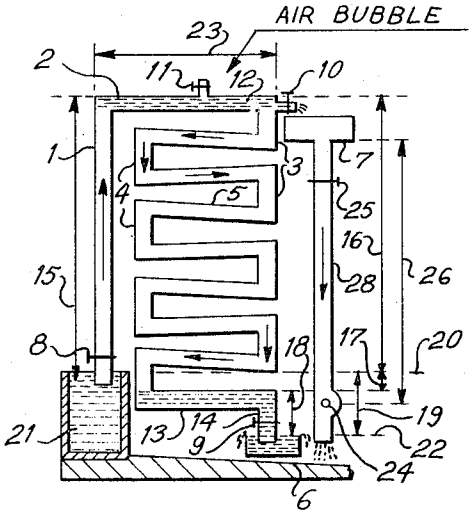


FIG. 2

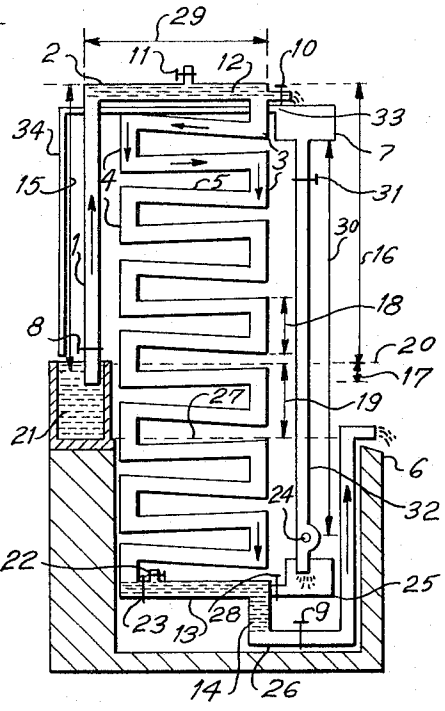


FIG. 3

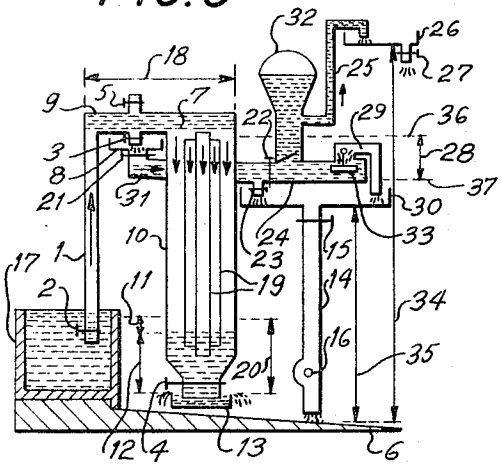
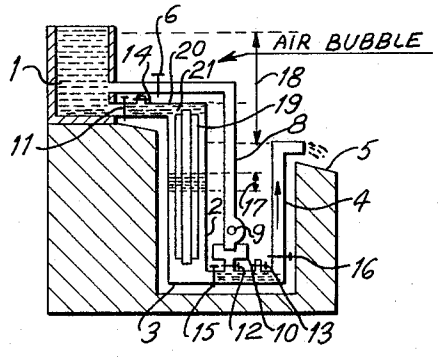


FIG. 4



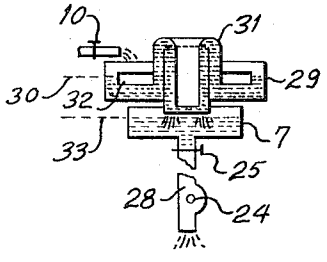


FIG. 5

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HYDRAULIC SYSTEM HAVING A NATURAL DIFFERENCE OF LEVEL, TO BE USED AS DRIVING POWER OR FOR OBTAINING OTHER BENEFITS

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6 Claims. (Cl. 60—55)

The present invention relates to hydraulic apparatus utilizing liquids in general and water in particular, flowing at a natural difference of level for the purpose of obtaining a driving force or other possible benefits.

The invention may be put into effect according to the principle illustrated in FIGURES 1, 2, 3, 4 and 5 of the accompanying drawing.

The main object of this invention is to provide a completely new source of motive power to drive turbines, generators and the like.

Another object of this invention is to provide a system for utilizing a flow of liquid from an elevated position to a lower position in order to gain maximum work from this flow.

A further object of this invention is to provide a novel siphon to elevate liquid before utilizing the flow of the liquid to do work or irrigation.

Other objects and advantages of this invention will be apparent upon consideration of the following detailed description of a preferred embodiment thereof in conjunction with the annexed drawing wherein:

FIGURES 1–4 are schematic illustrations of various embodiments of apparatus which embody the herein disclosed inventive concept. The claim 2 corresponds to FIG. 1; claim 3 to FIG. 2; claims 4 and 5 to FIG. 3; claim 6 to FIG. 4. FIG. 5 may be incorporated in any one of the modifications shown in FIGS. 1–4. Claim 1 is generic to each of FIGS. 1 to 4.

The description of this apparatus indicated in FIG. 1 is as follows:

The branch 1 of the siphon under description is immersed on its lower end in a basin 21 of flowing water as tidal water, river, etc., or water having a fall obtained artificially by the use of a weir. Said siphon also contains the horizontal branch 2 and another branch formed by a vertical serpentine indicated by sections 3, 4 and semi-horizontal sections 5. The construction of the serpentine (coil) of the siphon is such that the sum of the volume of water in any section 5 plus the volume of any section 3 (or 4) is equal to the volume of section 2. Due to this arrangement if the volume of air existing in section 2 is transferred to one of the combined sections 3 and 5 or 4 and 5 of the serpentine, the result will be that part of this air will be in a vertical section while the rest will be in a horizontal section. Only the water of each vertical portion 3 (or 4) will exercise its hydrostatic pressure upon the lower vertical sections so that the pressure at the base of the last vertical section will be a pressure equal to the sum of all the single pressures of all the above vertical sections 3 and 4.

This fact will make it possible to extract, for practical purposes, a greater quantity of water from the system than would be possible if such water were to be contained in a simple straight vertical tube only.

This result is obtained because the semi-horizontal sections 5 can be made of a length and of a volume such as is necessary in order to extract from the system a large quantity of water for greatest performance and economy of the system being used. However such a system may be also utilized with a very small water level differential as might possibly be found in nature.

The system indicated in FIG. 1 will function in the following manner:

By closing the cocks 8, 9 and 10, the system may be filled with water through the opened cock 11.

When cock 11 is closed and the cocks 8 and 9 are opened, the siphon will operate discharging water on the slope 6. Close cocks 8 and 9 and the siphon will be stopped full of water.

Open cocks 10 and 11 and the water contained in section 2 will discharge itself into the tank 7.

Air will thus fill section 2 creating an air bubble 12 in the system.

Cocks 10 and 11 are closed again and cocks 8 and 9 are opened.

The siphon will begin to operate and will carry the air bubble 12 downwards through the descending serpentine. The air will be divided in two different sections; a part in the vertical section 3 and the rest in the horizontal section 5; next it will be divided again part in the section 4 and part in the next section 5 and so on, until it will be located below in the last sections 13 and 14.

At this stage there will be two hydrostatic columns in the system:

(a) Column 1 of the height indicated by the measurement 15.

(b) The descending hydrostatic column indicated by the height 16 plus 17.

It is evident that column 16 is equal in height to column 15 and that column 17 is an addition to the descending column; therefore the siphon will continue its natural flow of water. By doing so the air bubble in sections 13 and 14 below will be expelled to the atmosphere and thereafter the water of the siphon will continue to discharge itself on the slope 6.

In the meantime, the water collected in the tank 7 by the previous operation will discharge itself through the connecting pipe 28 on the blades of the turbine 24 causing said turbine to revolve and produce mechanical energy.

In this system the descending hydrostatic column 16 plus 17 will always exist and will always be greater than the ascending column 15 regardless of where the air bubble is located at any moment during its descending course.

After the air bubble 12 has been discharged into the atmosphere, as already explained, the siphon being recharged completely with water, is ready to repeat indefinitely, the cycle explained.

In order to obtain said result, the siphon must be constructed so that the following physical rule must be always respected:

The height 18, common to every vertical section 3 or 4, of the serpentine must be always smaller than the height of the level differential 19 existing between the water level 20 in the basin 21 and the water level 22 in the point of discharge in slope.

In FIG. 1 the sections 5 of the serpentine are placed at an angle away from the horizontal position so that the higher end of each section 5 stays in the downward side of the flow. Such a construction is necessary in order to help the air bubble to follow, by its natural aptitude, the direction of the flow of the water avoiding backing up of the air to the top of the serpentine. The water obtained from the siphon on each cycle into tank 7 upon opening cocks 10 and 11 can be used:

(a) To be discharged onto a turbine in order to produce mechanical work of any kind including production of electrical energy.

(b) To be used at a higher elevation for irrigation, draining grounds or other purposes thus eliminating the necessity of pumps to lift the water to such a higher level.

(c) The water discharged from the turbine 24 can also be used for irrigation, or other purposes at that level.

The use of several separated systems for production of energy or other uses along the banks of a river can be economically facilitated by laying down, along a river toward a lower level, a discharging large pipe usable in common by several users.

It is obvious that for special industrial or chemical use, instead of the flowing water, any other liquid can be used.

The apparatus described in FIG. 2 is substantially the same in construction and in principle as that described in FIG. 1 up to the part shown above level 27.

In FIG. 2 the serpentine from point 27 has been extended more downwardly and curved upwardly so as to form a U tube as a communicating vessel, discharging again on the same slope 6 as in FIG. 1. Such a serpentine extension is located in a well which may be placed in liquid, in earth or other matter existing below the level 6.

The functioning of the system, of the FIG. 2 is as follows: The air bubble, when arriving at point 27, is allowed to descend further to a lower point than the level 6 while the water will still be discharged on the same slope 6 as in FIG. 1. When the air bubble has reached sections 13 and 14 it will be trapped therein by closing valves 9 and 23. In the meantime, the water tapped from cock 10 and used in turbine 24 will have discharged itself into tank 25. At this point, air-valve 22 will be open letting air out of sections 13 and 14 while valve 28 will be opened and the water from tank 25 allowed to enter in the sections 13 and 14 previously occupied by the escaped air bubble.

While this operation is going on the siphon is filled with water once more. As soon as valves 22 and 28 are closed and valves 23 and 9 are opened, the siphon will resume its flow and continue to discharge normally on the slope 6.

Now close valves 9 and 8. The siphon as explained in FIG. 1 will be ready for tapping new water at valve 10.

In order for this system to operate properly, this important factor of construction must be followed:

The air bubble captured in 12 and transferred and trapped in sections 13 and 14 will be reduced in volume because of the hydrostatic pressure exercised upon it. Therefore, when the water is recovered from tank 25 there would be not enough room in sections 13 and 14 to receive it all. To avoid this it will be necessary to connect a tube 34 to tank 7 at a level 33 wher the water volume in this tank will be equal to the volume of the compressed air bubble when reached in sections 13 and 14. The tube 34 will discharge the excess water back to the reservoir 21.

The system illustrated in FIG. 3 uses the same siphon principle explained in FIG. 1 but has the descending branch constructed as a straight vertical tube and also contains therewith a hydraulic ram system which can be used to major advantage of said system is needed.

The system FIG. 3 is built as follows:

The ascending branch 1 has its lower end immersed in water of the basin 17, the horizontal section 9 has an inlet-air valve 5 and a discharging valve 3 opening into tank 8; a pipe 31 is connected at the bottom of tank 8 and oriented downward from level 36 to level 37 where it is connected to a standard hydraulic ram system 24. The ram system 24 is provided with a drain valve 23 which discharges into a container 30; the container 30 is provided with a vertical tube 14 containing a stop valve 15 controlling fluid to be discharged onto turbine 16.

A valve 22 is provided between the tube 31 and the ram system 24 to be used in the case of exclusion of ram system 24 from system 3. The hydraulic ram system 24 is usually composed of the following parts:

An air chamber 32 having at its base a pipe connection 25 which raises upwards to a tank 26 located above the height of the siphon, and having at its bottom a discharge valve 27. This ram system also contains, as standard equipment, a valve 33 discharging water into tube 29 and into tank 30.

The system in FIG. 3 can be built with or without the use of the ram system 24.

When the system FIG. 3 is used without the ram system 24 it will function as follows:

The siphon is filled with water with all the valves in closed position, except valves 21 and 33. Then upon opening air valve 5 and valve 3 and the valve 23, the water 7 contained in the horizontal section 9 will discharge itself into tank 8 and subsequently through pipe 31 into tank 30.

Then close valves 5 and 3, open valves 2 and 4 and an air bubble will be pushed downward in branch 10 and subdivided through tubes 19 until it will be expelled in cup 13.

Then close valves 2 and 4 and the siphon is ready to be tapped again at valve 3. The water discharged previously in tank 30 can now be discharged through tube 14, by opening valve 15 (regulating flow) on the blades of turbine 16 in order to produce useful work. Even the water used in the turbine will discharge afterwards on slope 6.

When system of FIG. 3 is used with the hydraulic ram system 24 it will function as follows:

The water 7 is led to flow to container 8 by operating valves 5 and 3 as already illustrated. At this point close valve 23 and open valve 22; the water will rush to the ram system 24 and push against the bottom of valve 33 thus closing it but not before a certain quantity escapes through pipe 29 into tank 30. When the rushing water closes valve 33 it causes water to raise in the chamber 32 and by repeating such a process water will be made to overflow from the end of pipe 25 into tank 26 from where it can be used by opening valve 27.

The water collected in tank 30 from the overflow of valve 33 is thus used through pipe 14 and regulating valve 15 to act on turbine 16 and be discharged afterwards on slope 6.

When the system of FIG. 3 is used with the ram system it provides the advantage of lifting a percentage of water 7 to a height 34 which is higher than the height 35 obtainable by the use of the siphon only.

If the system of FIG. 3 is constructed without the hydraulic ram, then the pipe 14 leading water onto turbine 16 will be connected directly at the base of tank 8.

In order to have this system working the following construction principle must be followed:

The height of the air bubble when descending in branch 10 must be less than the level differential (12 plus 11) (20) between the water level of the basin 17 and the discharging level on cup 13.

The system illustrated in FIG. 4 is constructed without the use of a siphon but it is based on the same principles of operation as the structure shown in FIG. 2 because it also works by the principle of creating an air bubble and conducting it to a lower position than the point 5 where the water is expelled. This system is built in the following manner:

A U tube, formed by the three sections 2, 3 and 4 and located in a well placed in liquid, earth or other matter existing below the surface level 5, is connected at the top of the section 2 with a horizontal section 20 extending from a basin with flowing water and opening on the top end of section 4 for discharging the water above the well on slope 5.

Another tube 8 is connected on its top end above the connection of section 20 to the same water basin 1 and at the lower end made to discharge on a turbine 9 placed above collecting tank 10. Tank 10 is located above the horizontal section 3 and is connected to said section 3 by a nipple containing a shut-off valve 12.

The system will function as follows:

Starting with every valve of the system in the closed position and with the system full of water.

Open air-valve 14 and open valves 15, 16; water will start discharging on slope 5 and it will continue to do so

by level difference, sucking in air through inlet-air valve **14** at the same time.

When the desired volume of air has been introduced in tube **20**, the flow will be stopped by simply closing air-valve **14**.

Now open valve **11** and water from basin will circulate in the branch **2**, **3**, **4** because of water level differential **18**. The flow of water will push air bubble **21** downward to section **3** between valves **16** and **15**, where it will be stopped by closing valve **16** and trapped by closing valve **15**.

At this point open valve **6** and let water from basin **1** flow over turbine **9** through tube **8** until the volume discharged in tank **10** is equal to the volume of air trapped between valves **15** and **16**.

Now open air-valve **13** and valve **12** of the section **3** and the water from tank **10** will flow down and occupy section **3**, where air was trapped, while air escapes through valve **13**.

This system will work as illustrated only if the following construction principle is followed:

The diameter of section **2** must be calculated so that when the air from section **20** is carried therethrough it will occupy a section having a height **17** smaller than the differential level **18** existing between the top water level in basin **1** and discharge point **5**.

If the diameter of section **2** is so big that it will create a buoyancy problem of the descending air bubble, such a problem can be eliminated by the use of a number of vertical descending legs **19** in order to subdivide the air bubble in smaller parts each having less buoyancy—or by the use of a serpentine system as illustrated in previous FIGS. 1 and 2.

In order for this system to operate properly, the same requirement disclosed in FIG. 2 of compensating for the reduction of volume of the air bubble when reaching the bottom of the descending zig-zag leg exists. But in this system, the greater volume necessary can be taken care of by just leaving air valve **14** open a calculated fraction of time longer than necessary to evacuate section **20** thus increasing the air volume admitted so that when compressed at the bottom of said descending leg, it will occupy a volume sufficient to receive all the water discharged from container **10**.

It is necessary to indicate that the systems described in FIG. 2 and FIG. 4 have the built-in possibility of being used as systems to drain and dry wells having a natural spring at their base. This can be accomplished as follows:

The horizontal bottom section **26** in FIG. 2 and the horizontal bottom section between vales **15** and **16** in FIG. 4 can have valve-operated openings to collect water from the bottom of a well when said sections are closed and an air bubble is being evacuated from them. When such sections are filled with water, the air valves are closed, the collecting valves are closed, and the siphon is made to operate discharging the water on the slope **5** and recharging said bottom sections with a new air bubble, thus having the system ready to collect more water.

It is obvious for any skilled in the art to use means to hold constant the water flow upon the turbine wheel. One of the means is, for example, that represented in FIG. 5 where between the container **7** of the FIG. 1, for example, and the discharging valve **10**, there is interposed the container **29** having water up to the level **30**. In said container **29** there is a float **32** connected to a siphon **31** discharging water into container **7** where the water is contained to level **33**.

Through the valve **10** water discharges from section **2** in an intermittent manner, the float **32** moving up when valve **10** discharges into **29** and down when fluid discharges from container **29** into container **7**, the level **33** remaining constant because the siphon, by regulation or by construction discharges constantly, during each cycle, the same quantity of water discharged, through valve **25** from container **7** onto the turbine **24**.

These systems can obviously be used along an existing or to be installed pipeline of drinking or non-drinking water to establish a series of energy producing stations using the same water over again and producing the same effect as produced by waterfalls created by tapping of mounting water sheds.

Referring generally to the functioning of every system described herein the following observations are in order:

Where such systems are used in a location where the original water is subjected to change level either by tide or by season, they can be constructed so as to maintain the necessary difference in level of a constant value.

Such construction can be obtained for example by:

(a) Making the system associated with floatable means so that it will raise or lower itself with a change in water level.

(b) Constructing the discharge pipe (Example 4, FIG. 4) of an extendable nature as by using a bellows or telescopic construction (automatically extended by a river's water) and building the collecting tank for the body of water (FIG. 4, #1) at a height above any highest level expected.

It is obvious also to any skilled in the art that various modifications relative to the preferred embodiments disclosed herein by FIGS. 1 to 5 are possible and that the disclosed embodiments are exemplary only.

For example, the apparatus could be designed so as to eliminate some valves or making the control of the valves automatic by electrical or hydraulic means for the automatic control of the air bubble's course.

What is claimed is:

1. A hydraulic system, utilizing a body of water caused to flow by natural difference in level, and containing tanks, tubes and valves constituting, in their coordinated entirety, a hydraulic circuit of flowing water, said flowing water circuit being deprived, in an upper point of the system, of a quantity of water replaced by an air bubble, of height less than the height of said difference in level, said air bubble being dragged downwardly to a lower position by the same flowing water, said air bubble being expelled into the atmosphere and the corresponding water let to fall on a turbine wheel to obtain energy and then reintroduced below in the system or in some cases discharged on the ground.

2. A hydraulic system containing a siphon tube having an ascending liquid leg joined by a generally horizontal cross leg to a descending liquid leg curved in zig-zag form in such a manner that the sum of the volume of a vertical part with the volume of one semi- horizontal part of each curved portion must not exceed the volume of said horizontal cross leg, said ascending and descending legs each including a shut-off valve at its free end, said cross leg including an air-inlet valve opening into said cross leg, a liquid drain valve adapted to drain said cross leg, a lower container to collect the water drained through said drain valve, a descending pipe containing therein a turbine wheel, said descending pipe including a valve for regulation of discharging water, a body of flowing water, said free end of said ascending leg being submerged below the surface of said body of water, said descending zig-zag leg extending exteriorly of said body of water below the surface of said body of water, said descending zig-zag leg having each one of its vertical sections of a height smaller than the height between the surface of said body of water and the point of discharge of the siphon.

3. A power producing hydraulic system containing a body of flowing water, a siphon tube having a first ascending liquid leg upwardly joined by a first generally horizontal cross leg to a zig-zag descending liquid leg joined at its bottom end to a specially built section located below the discharging level, which, in turn, is joined to a sec-

ond ascending leg terminating upwardly at a discharging level, said discharging level being below the surface of said body of water by a height greater than the height of each vertical part of the zig-zag descending leg, said vertical part having a volume such that the sum of said volume with the volume of one semi-horizontal part must be not less than the volume of said highest horizontal cross leg, said first ascending leg having its free end submerged below the surface of said body of water, said first and second a scending legs each containing therein shut-off valves, said descending leg containing a lower shut-off valve, said first horizontal cross leg at the top and the horizontal section at the bottom including air-inlet valve openings into said cross legs, a liquid drain valve adapted to drain said top cross leg into a lower container, a pipe joined to said container draining water into a turbine wheel, a container for collecting the water falling from the turbine wheel, said container connected by a shut-off valve to the end of the lowest horizontal section, an overflow pipe connected at a level to tank and discharging at its lower end into a body of water.

4. A hydraulic system containing a siphon tube having an ascending liquid leg joined by a generally horizontal elongate cross leg to a large descending liquid leg, said descending leg sectioned by a number of tubes discharging at the bottom to a common end, said horizontal cross section including an air inlet valve for formation of an air bubble therein, a liquid drain valve adapted to drain said cross leg, a container to collect the liquid drained from said valve, a pipe joined with said container containing a turbine wheel at its discharge end, a body of water, said free end of said descending leg extending exteriorly of said body of water and below its surface at a height greater than the height that the air bubble has when descending to a point be expelled.

5. A hydraulic system containing a siphon tube having an ascending liquid leg joined by a generally horizontal elongate cross leg to a large descending liquid leg, said descending leg sectioned by a number of tubes discharging at the bottom to a common end, said horizontal cross section including an air inlet-valve, a liquid drain valve

adapted to drain said cross leg, a first container to collect the liquid drained from said valve, a pipe connected to said first container extending to a hydraulic ram, said pipe containing a drain valve discharging into a second container, a pipe joined to said second container containing a turbine wheel at its discharge end, said ram containing a stop valve, said ram containing an ascending pipe discharging water into a third container containing a discharging valve located above said horizontal cross section, said ram containing a valve opening downwardly and associated with a pipe discharging water into said second container, a body of water, said free end of said descending leg extending exteriorly of said body of water and below its surface at a height greater than the height that the air bubble has when descending to a point be expelled.

6. A power producing system containing a quantity of water, a descending pipe joined to said body of water including a shut-off valve and turbine wheel, another large descending pipe joined to the bottom of said body of water by a horizontal section and downwardly joined by a generally horizontal section located below the discharging level, said lower horizontal section being joined to an ascending pipe including a shut-off valve and terminating at a discharging level, said large descending pipe being sectioned unto a number of tubes discharging at the bottom in a common end, said descending large pipe including a shut-off valve and an air-inlet valve in a higher section opening into the pipe for producing inside the pipe an air bubble of volume such that during its descent said air bubble must have a height less than the height of the column of existing water in said body of water above the horizontal section including a shut-off valve and an air-inlet valve and a shut-off valve between the said section and a container which collects the discharged water from the turbine.

No references cited.

EDGAR W. GEOGHEGAN, *Primary Examiner.*