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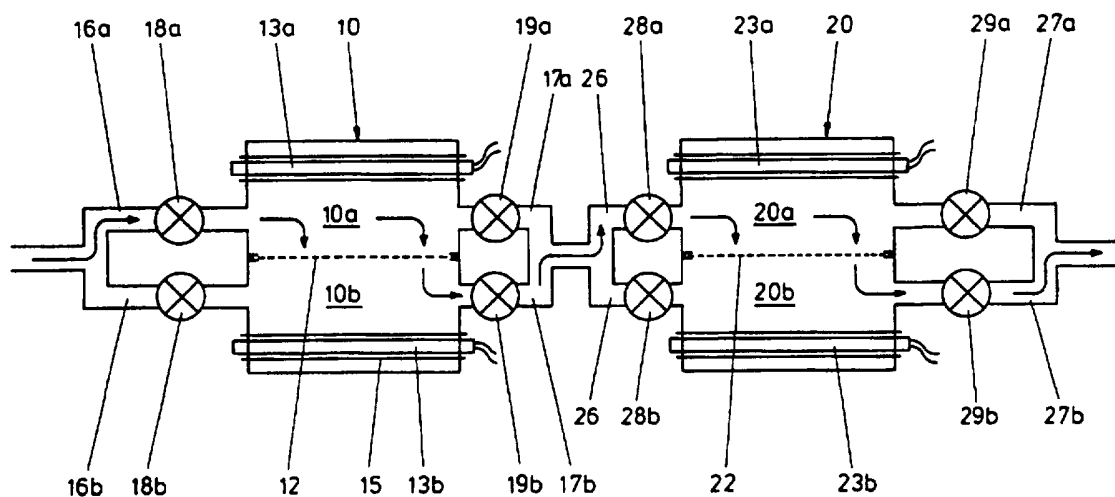
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(54) Title: FLUID TREATMENT APPARATUS

**(57) Abstract**

A fluid treatment apparatus comprises two titanium mesh filters (12, 22) connected in series across a flow passage. Each filter (12, 22) is irradiated by UV light from respective lamps (13a, 13b, 23a, 23b), so as to kill any microorganisms trapped on the filters. Backwashing means (18, 19, 28, 19) are provided for backwashing each filter in succession whilst fluid flowing along the passage is filtered by the other filter. In this manner microorganisms are unable to pass through the apparatus untreated.

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Fluid Treatment Apparatus

This invention relates to fluid treatment apparatus and more particularly, but not solely, to an apparatus for treating drinking water.

Drinking water may be contaminated with parasitic
5 micro-organisms such as Cryptosporidium and Giardias, which are particularly harmful to human beings if ingested. These micro-organisms are extremely difficult to treat by conventional means, since they are resistant to chlorine and other biocides. They are also relatively resistant to ultra violet radiation
10 owing to their thick outer membranes. However, it is known that the micro-organisms are susceptible to extremely high doses of ultra-violet radiation.

Conventional ultra-violet fluid treatment apparatus, such as the one disclosed in GB 2175779, comprise an elongate
15 tubular chamber having an axially extending ultra-violet light source. The dose of radiation supplied by the apparatus is equal to the product of the radiation intensity of the light source and the retention time of the fluid inside the chamber. A high fluid flow rate is needed, but it is impractical to
20 increase substantially the radiation intensity of the light.

We have now devised a fluid treatment apparatus which is able to effectively treat Cryptosporidium and Giardia parasitic micro-organisms but which can maintain a high fluid flow rate.

25 In accordance with this invention there is provided a fluid treatment apparatus comprising a flow passage, a plurality of filter elements mounted across the flow passage for filtering fluid flowing along the passage between an inlet and an outlet of the passage, backwashing means for reversing
30 the flow of fluid through a said filter element whilst fluid flows along the passage between said inlet and outlet through at least one other said filter element, and radiating means for irradiating a surface of the or each said other filter element so as to kill any trapped micro-organisms, the backwashing
35 means being arranged to reverse the flow of fluid through each filter element in succession whilst fluid flows along the

passage between said inlet and outlet through at least one other said filter element.

In use, any micro-organisms trapped by the filter are exposed to a continuous dose of radiation, which is sufficiently large to ensure that the micro-organisms are killed. Each filter is backwashed in succession, so as to remove any dead micro-organisms or other debris which may have built up thereon. At least one filter is arranged across the flow passage during backwashing of another filter, so that untreated micro-organisms are unable to pass through the apparatus.

Preferably the apparatus is arranged such that a predetermined delay occurs between reversing the flow of fluid through adjacent filter elements in the flow passage. Thus ensures that all of the micro-organisms receive at least the minimum amount of radiation required to kill them.

Cryptosporidium and Giardia micro-organisms are 4-6 microns in diameter, therefore the filter preferably comprises a filter material having pore sizes which are less than 4 microns.

Preferably the radiating means comprises an ultra-violet light source. Preferably the light source radiates short-wave ultra-violet light having a wavelength of 245-265nm, and particularly 253.7nm. Micro-organisms are most susceptible to radiation at these wavelengths. Preferably the radiating means irradiates opposite surfaces of the filter.

Thus, the flow of fluid does not need to be interrupted in order to perform backwashing.

In one embodiment the flow passage comprises a chamber divided into two longitudinally extending portions by a filter, each portion of the chamber being provided with respective fluid inlet and outlet ports, said backwashing means comprising valves connected to said inlet and outlet ports, and control means for selectively opening the inlet port of one portion of the chamber and the outlet port of the other portion of the chamber, so as to cause fluid flow in one direction through the filter. In order to reverse the flow of fluid through the filter the inlet and outlet valves of the opposite portions of the chamber are opened instead. It will be appreciated that

fluid continues flow between an inlet and an outlet of the chamber regardless of the direction of fluid flow through the filter.

In an alternative embodiment the filter is rotatably mounted in the fluid flow passage, said backwashing means comprising an actuator which rotates the filter through 180°, so that fluid flows through the filter in the reverse direction.

Preferably the filters are arranged in series.

In one embodiment, the filter comprises a mesh formed from titanium. When water contacts the filter it forms a titanium dioxide film on the surface of the mesh. This film reacts with the short-wave UV light to produce hydroxyls in the oxide surface. If a micro-organism comes into contact with this activated surface it is killed, owing to the oxidation of its cell wall.

In an alternative embodiment, the filter comprises a fibrous material which is transparent to radiation emitted by said radiation means.

Preferably the fibrous material comprises PTFE, which is transparent to short-wave UV light.

Embodiments of this invention will now be described by way of examples only, and with reference to the accompanying drawings, in which:

FIGURE 1 is a sectional view through an embodiment of water treatment apparatus in accordance with this invention; and

FIGURE 2 is a sectional view through an alternative embodiment of water treatment apparatus in accordance with this invention.

Referring to Figure 1 of the drawings, there is shown a water treatment apparatus comprising two elongate chambers 10,20 connected in series in a water flow passage. The first chamber 10 comprises upper and lower, longitudinally extending, portion 10a,10b separated by a titanium mesh filter 12. A pair of elongate ultra-violet lamps 13a,13b extend through the upper and lower portions 10a,10b of the chamber respectively. Each ultra-violet lamp e.g. 13b is mounted inside a quartz glass sleeve 15, which is sealed at its opposite ends to the walls

of the chamber.

The upper and lower portions 10a,10b of the chamber are connected at one end to respective branches 16a,16b of an inlet duct, and at the other end to respective branches 17a,17b of an outlet duct. The upper and lower branches of the inlet and outlet ducts 16a,16b,17a,17b are provided with respective fluid flow valves 18a,18b,19a,19b.

The second chamber 20 also comprises upper and lower longitudinally extending portions 20a,20b separated by a titanium mesh filter 22. A pair of elongate ultra-violet lamps 23a,23b extend through the upper and lower portions 20a,20b of the chamber respectively.

The upper and lower branches 17a,17b of the outlet duct of the first chamber 10 are each connected to upper and lower branches 26a,26b of an inlet duct to the second chamber 20. The upper and lower portions 20a,20b of the second chamber are connected at one end to the respective branches 26a,26b of the inlet duct, and at the other end to respective branches 27a,27b of an outlet duct. The upper and lower branches of the inlet and outlet ducts 26a,26b,27a,27b to the second chamber are provided with respective fluid flow valves 28a,28b,29a,29b.

In use, the valves 18a,19b are opened, such that water flows into the upper portion 10a of the first chamber, through the first filter 12 and into the lower portion 10b of the chamber. The valves 28a,29b are also opened such that water flowing out of the lower portion 10b of chamber flows into the upper portion 20a of the second chamber, through the second filter 22, into the lower portion 20b of the chamber, and out of the apparatus through the outlet duct 27b. Assuming that the ultra-violet lamps 13a,13b,23a,23b are illuminated, then any Cryptosporidium or Giardia micro-organisms in the water will be caught by the first filter 12, and held in front of the radiation from the lamps 13a,13b.

Assuming that the minimum time which the micro-organisms are held in front of the ultra-violet radiation is 5 minutes and that the lamps produce a minimum of 4mW/cm² of ultra-violet radiation, then the dose will be:

$$\begin{aligned} \text{Dose} &= 4 \times (5 \times 60) \\ &= 1200 \text{ mW Sec/cm}^2. \end{aligned}$$

It is known that a dose of 50-100 mW Sec/cm² kills Cryptosporidium and Giardia micro-organisms. Thus, the apparatus in accordance with this invention irradiates the micro-organisms with a dose which is 12 times greater than is
5 needed to kill them. Also, there is very little build up of other debris on the filter, since the apparatus is intended for use in treating clean drinking water.

After 5 minutes the valves 18b,19a are opened, and the valves 18a,19b closed, so that water flows in the reverse
10 direction through the first filter 12, thereby backwashing the filter. Any debris and micro-organisms caught by the first filter 12 are washed through onto the second filter 22, where they receive a further dose of radiation. After 5 more minutes the valves 28b,29a are opened, and the valves 28a,29b closed,
15 so that water now flows in the reverse direction through the second filter.

All the harmful micro-organisms on the second filter 22 have been killed, and thus the second filter can be safely backwashed into the flow stream out of the apparatus.

20 This process continues, so that the direction of flow through each filter 12,22 is reversed every 10 minutes, with a 5 minute interval between successive reversals, so that all micro-organisms caught by the apparatus are exposed to radiation for at least 5 minutes.

25 Referring to Figure 2 of the drawings, there is shown an alternative embodiment of water treatment apparatus comprising an elongate tubular chamber 30 connected in series with a water flow passage. A circular titanium mesh filter 31, having an annular seal 32 around its periphery, is mounted
30 normal to the direction of fluid flow, such that all of the water flowing through the apparatus is filtered. The filter 31 is mounted on a rotatable carrier 33, which also carries a pair of tubular ultra-violet lamps 34,35 mounted inside quartz glass sleeves 36. The lamps 34,35 are arranged to illuminate
35 opposite sides of the filter 31.

A second titanium mesh filter 41, having an annular seal 42 around its periphery, is mounted downstream of the first filter 31. The second filter 41 is mounted on another rotatable carrier 43, which also carries a pair of tubular

ultra-violet lamps 44,45 mounted inside quartz glass sleeves 46.

In use, micro-organism are trapped by the filter 31, which is mounted across the flow passage. The ultra-violet
5 lamps 34,35 illuminate the filter. After 5 minutes the carrier 33 is rotated through 180°, so that water now flows in the reverse direction through the filter 31, thereby backwashing the filter. Any debris and micro-organisms caught by the first
10 filter 31 are washed through onto the second filter 41, where they receive a further dose of radiation from the lamps 44,45. After 5 more minutes the carrier 43 is rotated, so that water now flows in the reverse direction through the second filter 41.

As before, all the harmful micro-organisms which have
15 collected on the filter 41 are killed by the ultra-violet radiation, and thus the debris from the second filter can be safely backwashed into the flow out of the apparatus.

Each filter is rotated through 180° every 10 minutes, with a 5 minute interval between successive rotations, so that
20 all of the micro-organisms caught by the filter are exposed to radiation for at least 5 minutes.

It will be appreciated that both embodiments of the invention deliver a dose of radiation to all of the trapped micro-organisms, which is at least 12 times greater than is
25 necessary to kill them. The mesh filters used do not significantly affect the water flow rate, so that there is little resulting loss in water pressure at the consumer. The effectiveness of the system can be increased by providing more than two filters.

Claims

- 1) A fluid treatment apparatus comprising a flow passage, a plurality of filter elements mounted across the flow passage for filtering fluid flowing along the passage between an inlet and an outlet of the passage, backwashing means for reversing the flow of fluid through a said filter element whilst fluid flows along the passage between said inlet and outlet through at least one other said filter element, and radiating means for irradiating a surface of the or each said other filter element so as to kill any trapped micro-organisms, the backwashing means being arranged to reverse the flow of fluid through each filter element in succession whilst fluid flows along the passage between said inlet and outlet through at least one other said filter element.
- 2) A fluid treatment apparatus as claimed in claim 1, arranged so that a predetermined minimum delay occurs between reversing the flow of fluid through adjacent filter elements in the flow passage.
- 3) A fluid treatment apparatus as claimed in claims 1 or 2, in which the filter element comprises a mesh of titanium.
- 4) A fluid treatment apparatus as claimed in claims 1 or 2, in which the filter element comprises a fibrous material which is transparent to radiation emitted by said radiating means.
- 5) A fluid treatment apparatus as claimed in claim 4, in which the fibrous material comprises PTFE.
- 6) A fluid treatment apparatus as claimed in any preceding claims, in which the radiating means comprises an ultra-violet light source.
- 7) A fluid treatment apparatus as claimed in claim 6, in which the light source radiates ultra-violet light having a wavelength of 245-265 nm.

8) A fluid treatment apparatus as claimed in claim 7, in which the light source radiates ultra-violet light having a wavelength of 253.7 nM.

9) A fluid treatment apparatus as claimed in any preceding
5 claims, in which the flow passage comprises a pair of chambers each divided into two longitudinally extending portions by respective filter elements, each portion of each chamber being provided with respective fluid inlet and outlet ports, said
10 backwashing means comprising valves connected to said ports and control means for selectively opening the inlet ports of one portion of each of the chambers and the outlet ports of the other portions of the respective chambers.

10) A fluid treatment apparatus as claimed in any of claims
1 to 8, in which each filter is rotatably mounted in the fluid
15 flow passage, said backwashing means comprising actuators which rotate the filters through 180°, so that fluid flows through the latter in the reverse direction.

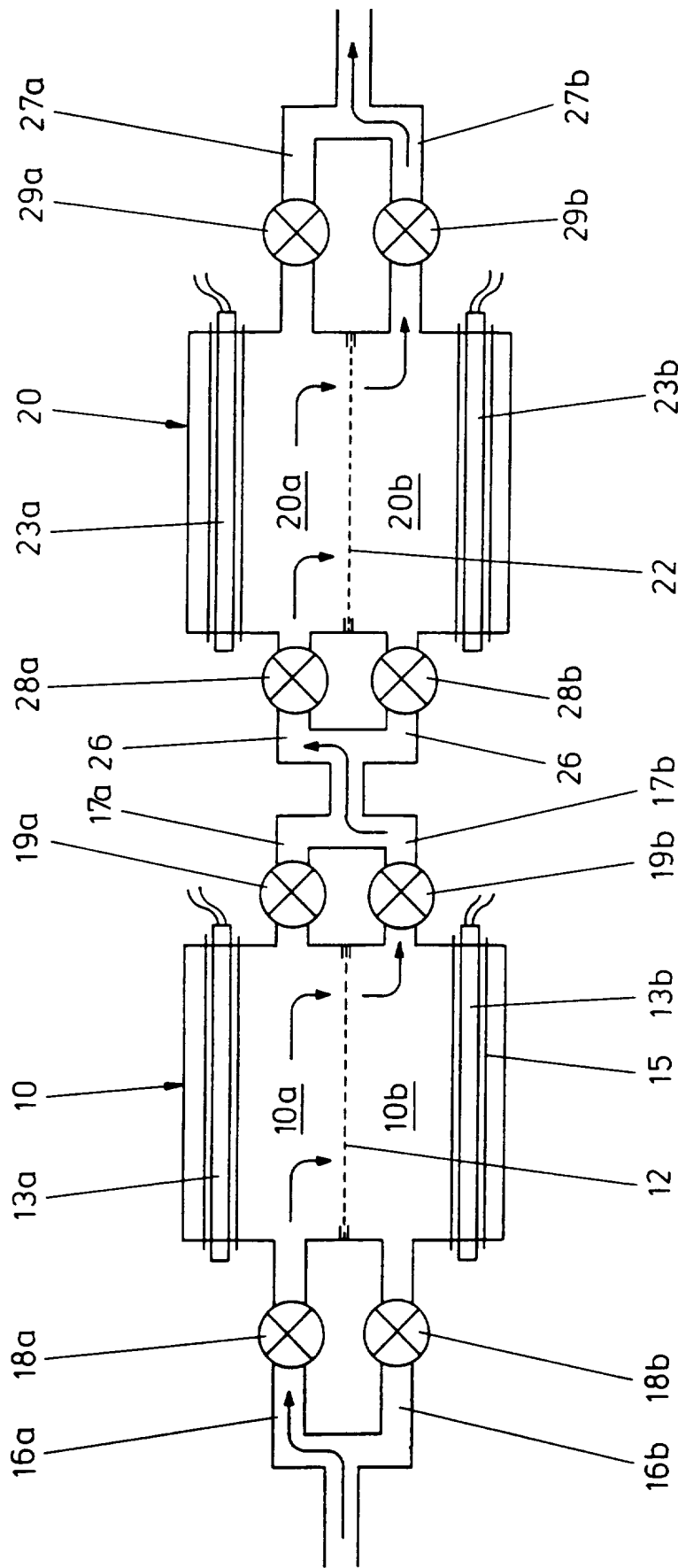


FIG. 1

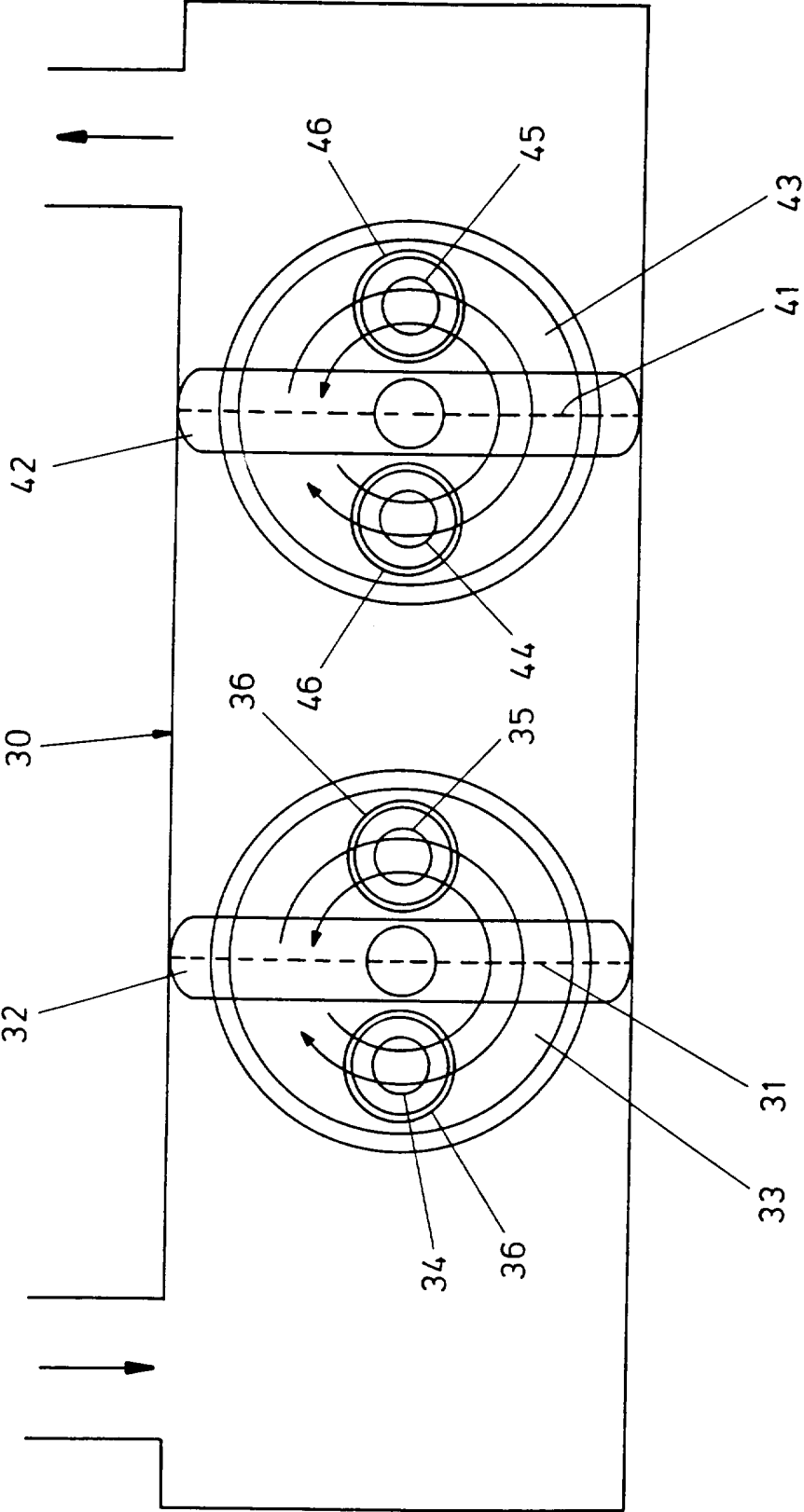


FIG. 2

INTERNATIONAL SEARCH REPORT

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PCT/GB 95/01905

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C02F1/32 A61L2/10 B01D29/01 B01D29/66

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C02F A61L B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 008 no. 067 (C-216) ,29 March 1984 & JP,A,58 220000 (TOKYO SHIBAURA DENKI KK) 21 December 1983, see abstract ---	1,6
A	DE,A,32 47 747 (KOOP HERMANN DIPL ING) 4 August 1983 see the whole document ---	1,4,6
A	EP,A,0 316 687 (KNIGHT JOHN B JR) 24 May 1989 see abstract ---	1,6
A	WO,A,94 06482 (PICK WILLIAM E) 31 March 1994 see page 7, line 25 - page 8, line 4 -----	10

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