PATENT OF INVENTION

ES 2 331 034 B1

Applicant:
DEPURATION FOR LASER INFRARED. DELAIR, SL

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GRAPH (ONLY TO INTERPRET SUMMARY)

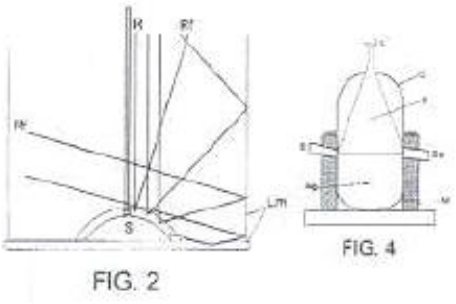

FIG. 2

FIG. 4

Title:
DEVICE FOR TREATMENT AND DISINFECTION OF SOLIDS AND FLUIDS BY LASER RADIATION

Abstract:

It consists of a device based on a diverging lens (L) variable aperture terminal adapted to head a laser generator, based on the use of a device consisting of a diverging lens aperture terminal variable adapted to the head of a laser generator that emits radiation in the spectrum wavelength between 0.38 and 1000 microns. The diverging lens (L) of polygonal, cylindrical or spherical used to broaden the scope of coverage spread-do the laser beam (R) on the treated surface, radiating head energy in closed and open-you north of pollutant to be removed. Replacing the diverging lens (L), for treatments in manholes, deposits or the like, you can use a device consisting of a reflective metallic element (S) of forms hemispherical, conical or polygonal located at the bottom of cavity, which is fully covered with a foil (Lm) also reflective of Aluminum, Copper, Stainless steel or other similar material.

DEVICE FOR TREATMENT AND DISINFECTION OF SOLIDS AND FLUIDS BY LASER RADIATION

DESCRIPTION

The invention is designed to treatment and disinfection all kinds of solids and fluids (liquids and gases), characterized by use generators emitting laser in pulsed and continuous wave within the limited of 0.38 to 1000 microns, to which they are installed in his head terminal (output coupler) a device consisting of a diverging lens of zinc selenide (ZnSe), gallium arsenide (GaAs), fluorite (CaF), germanium (Ge), quartz (SiO) or similar material (FIG.1), variable opening under the surface to be treated in manholes, deposits or similar. The device, for treatment in boxes, may be a reflective metallic element of hemispherical, conical or polygonal (FIG. 2), located at the bottom of the cavity, which is completely coated with a reflective foil equally Aluminum, Copper, Stainless steel or similar material. It is in the scope of technology Laser Visible (VIS) and infrared (IR) for the disinfection of microorganisms and surfaces cleaning.

BACKGROUND

DELAIR as proprietress of the Patent No. 9201708 "Laser Device for the purification of contaminated water", has been doing in recent years for research and development work of Investigation and Development for Innovation of the patent and its application to different fields.

Based on the source of the various volumes of "**The Infrared & Electro Optical System Hanfbook**" and drawing the diagram (FIG. 3) on page 266 of VOLUME 1 "Sources of Radiation", according to the Wavelength in microns, we get the absorption coefficient in cm^{-1} for each type of radiation. With the above mentioned parameters and for application of the Law of Beerschen, we have calculated the depth of penetration of the Radiation water (Table 1), and made the correspondent comparative energy with ultraviolet radiation (Table 2).

TABLE 1
Depth of penetration the water

$I_t = I_0.e^{-\sim.cd}$ **Law of Beerschen**

I_t = Transmitted Intensity
I_0 = Intensity incident light
α= Absorption coefficient
c =Concentration= m/Pm =$1x10^{-3}/100= 10^{-5}$
d = Penetration depth
T= Transmittance = 0.60
$LI_t = LI_0 - \alpha.cd.Le$ $\alpha.cd = LI_0 - Li_t$

$\alpha.cd = L \frac{I_0}{I_t}$ $I_t = I_0.T$

$\alpha.cd = L \frac{1}{0,60}$ $\alpha.cd = L\ 1,667$

$\alpha.cd = 0.51$ Ĝ **$d = \frac{0,51}{\sim.c}$**

For laser generator of Nd:YAG

Absorption coefficient $\alpha = 0.8$

$d = \frac{0,51}{0,8x10^{J5}}$ = 63,750 cm = 637,50 m

TABLE 2
Comparative energy UV - IR

$N_t = N_0.e^{-\sim Jt}$

N_0 and Nt = N° of bacteria earlier and later
α= Absorption coefficient
Jt=Power

$LNt = LN_0 - \alpha.Jt.Le$

$\alpha.Jet = LN_0 - L\ N_{ot}$ $\alpha.Jet = LN_0/N_t$

$LN_0/N_t = Ln$ Ĝ **Jet = Ln / ~**

1. For Ultraviolet

$\lambda_1 = 254\ N_m = 0.254\ \mu m$ $\alpha_1 = 0.05$
$J_1 t_1 = Ln/0.05$

2. For IR laser generator of CO2

$\lambda_2 = 10.6\ \mu m$ $\alpha_2 = 8$
$J_2 t_2 = Ln/8$

3. Powers for a same concentration

$Ln = 0.05\ J_1 t_1$
$Ln = 0.8\ J_2 t_2$

$0.05\ J_1 t_1 = 8\ J_2 t_2$ Ĝ **$J_1 t_1 = 160\ J_2 t_2$**

To eliminate the same concentration of microorganisms is needed a power of irradiation UV 160 times greater than IR.

As the air and water transmission means of radiation, we proceeded to issue the relevant evidence in the Laser Technology Center of Castile and Leon, with water and 2 different types of lasers of different wavelength (λ_1=1,06 microns and λ_2=10,6 microns), without making and pre-treatment Roughing – Screening – Coagulation – Flocculation – Setting or Filtration. These tests are duly certified by the Centre and the Food Agriculture Laboratory EPTISA and summarized in Tables 3 and 4.
An after identical circumstances Laboratory ALCORA SA, made the corresponding Analysis of waters of the Navacerrada Dam, before and after being subjected to irradiation by generator laser of Nd:YAG facilitated by ROFIN BAASEL SPAIN, that confirmed their disinfectant effect as reflected in Table 5.

TABLE 3

Water of the Canal of the Duero

PARAMETERS	Water of the Canal without Treat	Water of the Canal Treated with IR
Sulphates	5 mg/l.	4 mg/l.
Nitrites	0.01 mg/l.	0.00 mg/l.
Oxidation	2,30 mg/0.2 l.	1,82 mg/0.2 l.
Total germs	7.480 / ml.	2.600 / ml.
Totals coliforms	2.800 / 100 ml.	240 / 100 ml.
Fecal coliforms	880 / 100 ml.	43 / 100 ml.
Fecal streptococcus	20 / 100 ml.	0 / 100 ml.

TABLE 4

Water of the EDAR of Palencia

PARAMETER	Water EDAR without Treat	Water of the EDAR Treated with IR
BOD	15 mg/l.	4 mg/l.
BOD5	10 mg/l.	3 mg/l.
Totals coliforms	76.000 / 100 ml.	24.000 / 100 ml.
Fecal coliforms	46.000 / 100 ml.	11.000 / 100 ml.

TABLE 5
Water of the Dam of Navacerrada

PARAMETERS	Water of the Dam Navacerrada without Treat	Water of the Dam Navacerrada Treated 99M
Oxidation	4 mg/l O_2	1,5 mg/l O_2
Totals coliforms	>1.100 ufc/ml	20 ufc/ml
Fecal coliforms	460 ufc/ml	15 ufc/ml
Fecal streptococcus	7 ufc/ml	< 3 ufc/ml

DESCRIPTION OF THE INVENTION

The radiation from the visible to far infrared wavelengths comprises between 0.38 and 1000 microns, and in relation infrared radiation we have to specify that it is not possible to see it, but if to feel it in the shape of the heat.

Radiation disinfection is a physical process defined by the transfer of electromagnetic energy from laser generating source to the cellular genetic material from one organism located in a solid or fluid. The effects of this energy are to incapacitate the cell to reproduce and to eliminate it by heating, due to the big sensibility of the microorganisms to high temperatures. The radiation produces photo-physical reactions photo-activating the dynamic processes at the molecule and electronic activation in the atoms, originating one warming at different levels and changing to calorific energy.

The effectiveness of radiation is a direct relation of the amount of calorific energy that is absorbed by microorganisms. This dose is the product of the intensity and the time of exposure to the intensity. Most of the microorganisms require a very low level of energy to be destroyed.

The present tendency is to look for alternative water available for agricultural irrigation and of gardens, industrial uses or toilets, etc. The reuse of water is an element of the development and management of water resources that provides innovative options and alternatives for agriculture, industry and municipal supply. The possibilities for reuse of treated waste water are many and varied, highlighting the most frequent destination as agricultural irrigation, so the need to reuse waste water will be gradually raised increasingly. Agriculture in arid and semiarid areas depends almost entirely on irrigation, and demand for water for irrigation represents a percentage that in many cases exceeds 80% of the total demand for water.

The elements present in sewage, which may limit its use in irrigation, are as follows: Suspended solids, biodegradable organic matter (BOD or BOD_5), pathogens (viruses, bacteria, protozoan or helminthes), nutrients (excessive nitrogen, phosphorus or potassium), non-biodegradable organic matter (phenols, pesticides and organ-chlorinated), water pH, heavy metals (cadmium, mercury, zinc and others), electrical conductivity (derived from the presence of ions Na, Ca, Mg, CI, or B), residual chlorine (concentrations of free radicals of chlorine superiors the 0,5 mg/l limit the application to sensitive cultivation).

This requires a tertiary treatment to ensure the hygienic-sanitary quality suitable for reuse of usage required. With regard to the presence of totals coliforms, fecal coliforms, fecal streptococcus and other microorganisms, current technologies are not effective enough, so in many cases come to the chlorination, treatment that in the presence of organic compounds leads to the formation of trihalomethanes or organ-halogens, of carcinogenic character, therefore the receiving river beds not have of take superiors spills to 0.1 mg/l.

The fate of reused water, irrigation of vegetables of raw consumption, etc.., imposes a high demand of sanitary quality, which requires the addition of a disinfectant or tertiary treatment, to the water proceeding from the municipal sewage treatment plant. Ozone is used as a disinfectant in general, by the facility whereupon it gives off oxygen, it is an oxidizing chemical agent, being a component that dissociates into reactive free radicals. Oxidized to nitrites, sulfides, sulfites..., passing them to sulfates and nitrates, and it leaves to free iodine in the iodide dissolutions. Foments when some by-products of ozonization combine with secondary processes of disinfection Trihalomethanes formation (THMs), with a marked toxic character, mutagenic or carcinogenic.

The waste water, once they have received secondary treatment at the EDAR, they are stored in a deposit of reception covered, which has a center of elevation and a filtering station. The filtered waters receive a tertiary treatment of disinfection by means of ozone to the end of eliminating the present microorganisms in the water and to make it suitable for his use in irrigation.

A process of filtration and disinfection after tertiary treatment with radiation in a manhole of step (FIG. 4), by means of a device with generating laser VIS and/or IR instead of ozone, it would be:

- more effective.
- less expensive.
- does not entail any risk to human health.

Blood Treatment. The blood includes red and white cells, and a liquid part without cells, plasma. The blood represents 1/13 of the total weight of the human body (5 liters in a person of 65 kg of weight) and circulates through the arteries and veins. It is of alive red color in the arteries and dark in the veins.

It is constituted by three cellular groups: erythrocytes or red cells, leucocytes or white cells and platelets or thrombocytes. The platelets and the red blood cells are exempt from nucleus and have sizes, forms and functions more or less standard. The white cells, however, have varied shapes, colors and their functions also differ considerably from one class to another. They are the only blood cells that can fulfill functions out of the circulatory torrent.

Red cells or erytrocytes are cells of 7-8 microns diameter, carry within them a substance called hemoglobin that gives it the color of blood, specializing in transporting oxygen (O_2) and carbon dioxide (CO_2) between the tissue and pulmonary circulation. In each cubic millimeter of blood, there are 4.5 to 5.5 million of them, representing 45% of blood volume.

The leucocytes or white cells are cells of 6-18 microns of diameter with immune functions that are found in the blood, depending on type, its number oscillates between 5,000 and 9,000 per cubic millimeter.

The platelets or thrombocytes, are cells responsible for the first phase of clotting, so that its functions are limited to blood torrent. Are fragments of cellular cytoplasm of 3 microns of diameter.

The viruses, are organizational entities composed only of genetic material, surrounded by a protective shell, are the cause of many different diseases in humans, animals and plants. The smallest viruses are between 18 and 20 nanometers wide, the larger are the elongated, some measuring several micrometers of length, but usually do not measure more than 100 nanometers wide (0,1 microns).

If in a stainless steel receptacle or other reflecting metallic material, we placed as a dividing element one semi-permeable membrane with pores of 1-2 microns and we made Reverse Osmosis, the water along with the polluting microorganisms happens to the other side through the membrane, being separated from the rest of the components. Concentrating on that zone and in relation to the microorganisms to eliminate, a small amount of electromagnetic energy of wavelength between 0.38 and 1,000 microns (VIS-IR), by means of a diverging lens adapted to the terminal compress of a laser generator (FIG.5), taking advantage of the properties of the radiation and their transformation in thermal energy in its interaction with the alive matter, and to the being the average air and the water of transmission, they allows to purify and to disinfect this means, destroying the microorganisms in seconds, using a power of very low emission.

Treatment of juices, beer, milk, liquid egg, etc. It is radiated with a diverging lens fitted on the terminal compress of a laser generator and in small intensities, depending on the amount of microorganisms to purify, in order not disturb the nutrients, since it treats of scattering or multiple diffusion of laser light, therefore, warms more and destroys more bacteria that in water, but if transmits heat in excess modifies the nutrients properties. Obviously is a quick and effective method, but it will have to begin with low intensities, in relation to the bacteriological mass to eliminate.
Due to spatial spreating and angular spreating decreases the total transmission, for consequent absorbs and warms purifying the bacteria, but without exceeding the power for not destroy the vitamins.
Transmission along the sample. The change in the intensity of propagation at a distance dx is proportional to the intensity and a constant. This constant is given by the extinction coefficient:

$$\beta_{ext} = \beta_{absorption} + \beta_{diffusión}$$

$$\mathbf{I_x = I_0.e^{-\ .x} = I_0.e^{-\beta length.thickness}} \qquad \textbf{BEER LAW}$$

I = Intensity Laser

The transmission is the ratio of the intensity transmitted with the incident. $\mathbf{e}^{-\beta length,\ thickness} = \frac{I_X}{I_o}$

This, in the case that the medium is uniform to spread the laser beam through it.
In the event that the properties of diffusion of the sample vary along the path, the transmission is:

$T = \mathbf{e}^{-\ length,.\mathbf{ds}}$

By increasing the density and therefore the concentration of particles, increases the coefficient of absorption and for consequent the power of purification compared to H_2O.
For any type of laser radiation, knowing the thickness, the intensity of the incident laser and by measuring the intensity transmitted, the coefficient is calculated by the $\beta_{extinction}$ and the power of purification.
Measuring the intensity transmitted.
Knowing the intensity of the incident laser, which crosses the samples 30 cm thick in the case of milk and juice and 5 mm for liquid egg, with a photo-tube is measured the intensity transmitted.
Knowing the intensity transmitted, the incident intensity and the thickness, we calculate the coefficient $\beta_{extinction}$ and the scrubber power of the intensity of the incident laser.
We know, for the curve for water:

$$\beta_{extinction} \approx \beta_{absorption}$$

$$\beta_{extinction} = (\beta_{absortion\ of\ water} + \text{density of the sample } -1\ ).\ \beta_{absortión\ of\ water}$$

By measuring the density, we can know approximately the $\beta_{extinción}$ with regard of the $\beta_{absorción}$ of the water.
The $\beta_{extinction}$ of water is taken from the curve of transmission for the laser to use.
If the milk has a density of 1.1 gr./cm3 (kg/l), it is has:

$$\beta_{extinction} \approx \beta_{absortion\ of\ water} + (1{,}1-1).\ \beta_{absortion\ of\ water}$$

Taking like density of the water (1 kg/l) for a wavelength laser λ=1'06 μ, in the curve of transmission we obtain a coefficient of absorption $\alpha = 0{,}8\ cm^{-1}$.

$$\beta_{extintion} = 0{,}8 + (1{,}1\text{-}1) \cdot 0.8 = 0{,}8 + 0.1 \text{ x } 0{,}8 = 0.88 \approx \mathbf{0{,}9}$$

Calculation of the power necessary for application of the Beer Law.
If the thickness for milk or juices is x=5cm, for a certain power, we can calculate the intensity transmitted through the equation of Beer:
Si el grosor para la leche o zumos es x=5cm, para un cierta potencia, podemos calcular la intensidad transmitida por la ecuación de Beer:

$$I = I_o.e^{-\beta extinción.espesor}$$

a) For a power of 100 watts.

$I = 100\ \frac{watts}{cm^2}.e^{-0,9 \times 5}$ $\quad e = 2,7183$

$LI = lg\ 100 - 4,5\ lg\ 2,7183 = 2 - 4,5 \times 0.435 = 2 - 1,96 = 0.04$

$I = antlg\ 0.04 = 1,10\ watts/cm^2$

b) For a power of 20 watts

$I = 20\ \frac{watts}{cm^2}.e^{-0,9 \times 5}$ $\quad e = 2, 7183$

$L\ I = L\ 20 - 4,5.\ Le = 3 - 4,5 \times L\ 2,7183 = 3 - 4,5 \times 1 = -1,5$

$I = antL(-1,5) = 0.22\ watts/cm^2$

Effect of pasteurization of beer by infrared radiation. Generally the beer is elaborated with yeast, barley malt, hop and water. The elaboration begins in the mills of malt, that they spill to a tank of infusion, where is macerated to 65 degrees of temperature. Then the malt is separated from the liquid and is passed to a baking tank, where it remains during average hour. Once leaves the tank, the temperature lowers quickly until the 10 degrees, to avoid the contamination apparition. It is deposited in steel receptacles and it ferments 2 times, one first series of 1 week and other one of 40 days, it filters and bottled.
All the existing methods of pasteurization and sterile filtration can have a negative impact in the beer. The laser of infrared radiation can be used in new nondestructive methods of pasteurization of the beer because not cause molecular ionization and is not detrimental for the quality of the beer.
Short-term exposure of beer to the laser infrared radiation suppresses greatly the propagation of the yeast and eliminates bacteria. The high penetration capacity of radiation Infrared allows the treatment of bottled beer. The "pasteurization infrared laser" does not have disadvantages in terms of product quality and because of its very low power consumption, low price and wide availability of infrared lasers, it is cheaper than any of the other methods currently used by the breweries. The high capacity of penetration of the infrared radiation allows the treatment of the beer bottled. The "laser infrared pasteurization" does not have disadvantages as for the quality of the product and due to its consumption very low of energy, his low price and the great availability of infrared lasers, turns out to be cheaper than any of other methods used at present by the brewing industries.
Treatment of fodder and flours. The making of fodder compounds in the world is superior to 600 million tons, of which to Spain correspond approximately 14 millions.
Between the raw materials principals that intervene in the process and that are stored in silos or deposits, for their later milling and treatment, it is possible to mention, the soybean, the maize and the wheat, contaminated raw materials that affect the contamination of the finished fodder. The microorganisms that affect more are the bacteria, the coliforms, the presence of fungi in the maize and some contaminations by salmonella in the soya.

In the United Kingdom using treatments for heat they managed to reduce the contamination for salmonella in food for birds of 30% to 6% in 3 years. The great economic importance of manufacture of fodder in our country allows the incorporation of new technologies to its process of elaboration, for what the treatment by means of emission stimulated of radiation VIS or/and IR inside the wave length bactericidal between 0.38 and 1000 microns would produce a calorific effect provoking the elimination of the pollutant microorganisms.

Water treatment in swimming pools. All the swimming pools, they require a disinfection to reduce the total of microorganisms in the water. Traditionally there have been used the disinfectants based on the chlorine, that originate problems due to the formation of chlorinated by-products, as the chloramines. The formation of chloramines is due to the reaction of chlorine with ammonia (or urea), that are spilled by the bathers. These chloramines cause "red eyes", irritation of skin, characteristic scent and can be carcinogenic.

By means of the use of a system of disinfection by radiation VIS or/and IR, the concentration of chloramines is reduced considerably, when descending to a great extent the metering from chlorine.

For the application of the system of IR Laser in the sterilization (disinfection) of swimming pools, it will have to be considered if it is an existing swimming pool or, on the contrary, of new construction. In the scheme the recirculation is divided in two parts:

In the first part we incorporated a recirculation, which also can be with independent bomb, in which a part of the water, in the random time must pass all the water of the swimming pool, by the manhole of Laser treatment.

The second it is a traditional system of sand filter, to maintain a scarce turbidity in the water and to improve like that the yield of the Laser.

In one third stage the chlorine dosage takes place or alternative chemical treatment and the thermal stability (thermostatic) if there were it, reincorporating the water in the bath sink. Only with this performance the quantity of necessary chlorine diminishes in fifty per cent. Nevertheless all this, following of a series of conducts in the cleanliness we will reduce much more this quantity. Of a part in the process of cleanliness of the filter, we will lower the water level up to the discontinuous line B (FIG. 6), resorting then to a hyper-chlorination investing the recirculation from the habitual exit to the canal that previously we have emptied, treating hereby the pipelines of conduction to avoid the development of colonies in elbows etc.; at this moment we re-put the level of the water, and though we have done hyper-chlorination, this volume is very small in comparison with the total capacity of the bucketful of bath for what we will be able to fit the quantity of chlorine alone to the maintenance of the same, coming to values of near of twenty per cent or less.

Using the means of cleanliness of funds, walls and corners we will turn the water of the cleans-funds aside after of filtered towards the unit of laser.

The FIG.6 shows an example of installation of radiation VIS or/and IR in a swimming pool.

Conditioned Air Treatment and Operating Rooms. The laser radiation of emission in wave pressed and continuous between the limits of 0.38 1000 microns, eliminates the microorganisms, by the what this system can be utilized to process the water and to purify the air in installations of conditioned air, operating rooms, and cleanliness and disinfected of towers of refrigeration. The FIG. 7, 8 and 9, they show an example of purification at conduits of conditioned air, air at operating rooms and water of towers of refrigeration.

Treatment and cleanliness of exterior revetments. This procedure is of general application, because without damaging the surface realizes an integral cleanliness, can be utilized on polychromes and fragile surfaces. The procedure is less aggressive and more rapid for the stone and other materials, needing a minor effort for the worker, which as the only protection needs to use only a few protective glasses.

The laser works for the amplification of the energy, in this case an intense beam, which produces a flow of coherent light of specific wavelength. This type of laser emits infrared light and also visible, most of this energy becomes immediately heat superficial (principal effect of laser) that warms the dirt layer, provoking his vaporization.

At the same time the rest of light passes the about material originating a light thermal expansion and a contraction of the surface that causes a shock wave and a sonorous effect. The explosion of the layer of vaporized dirt contributes to the effect of shock and collaborates to eliminating. The density of this treatment, transforms into seconds the black layer of dirt in a clean surface, without than this one loses his original properties.

DESCRIPTION OF THE FIGURES

FIG. 1 corresponds to the Device, consisting of a diverging lens of zinc selenide (ZnSe), gallium arsenide (GaAs), fluorite (CaF_2), germanium (Ge), quartz (SiO_2) or another similar material, of variable opening in accordance with the surface to treat. The diverging lens (L) of polygonal form, cylindrical or spherical is used to extend the coverage field, distributes the laser beam (R), radiating calorific energy in spaces closed and opened to tenor of the pollutant mass to eliminate.

FIG. 2 shows the Device, for treatments in manholes, deposits or similar, is a reflecting metallic element of semispherical form, conic or polygonal, situated in the bottom of a cavity, that is totally coated for a metallic sheet equally reflecting of Aluminum, Copper, stainless Steel or another analogous material. Abbreviations represent:

R: Laser radiation.
S: Hemisphere.
Lm: Reflecting metallic lamina.
Ri: Reflected radiation.

FIG. 3 is copy of the diagram of page 266 of **VOLUME 1 "Sources of Radiation".** In abscissas the wavelengths are indicated (Wavelength) in micron, by means of which we obtain in ordered the Coefficient of Absorption (Absorption Coefficient) in cm^{-1} it stops each type of radiation.

FIG. 4 talks about a Disinfection of the water to its passage by a manhole, by means of laser irradiation. Abbreviations represent:

A: Water.
L: Diverging lens.
E: Entrance of water.
Sa: Exit of water.
Lm: Metallic Aluminum lamina hard anodizing or similar.
C: Metallic pointed hood of he himself material.
R: Laser radiation.

FIG. 5 previously represents the process of Disinfection of Blood making Reverse Osmosis the disinfection. The used abbreviations are the following ones:

L: Diverging lens (Device laser)
P: Pressure
Ms: Semi-permeable membrane with pores of 1-2 micron

FIG. 6 corresponds to the system of water disinfection in swimming pools. The used abbreviations represent:

1. Sterilization by laser irradiation.
2. Filtering and pumping.
3. Heated and small-chlorination.

A. Overflow

B. The water level in the process of cleaning of filter

FIG. 7 treats of a transverse section and longitudinal other one of a conduit of air conditioning, where the red lines, represent the effect of reflection of the laser beam inside the metal conduit. The used abbreviations are the following:

4. Laser generator.

L. Diverging lens.

FIG. 8 corresponds to the purification of the air in operating rooms and other enclosures by means of a laser generator of small size and low power. Used abbreviation R, represents the emitted Radiation.

FIG. 9 corresponds to the disinfection of water in cooling towers by means of a laser generator of characteristics similar to the previous one. Used abbreviation R, represents the emitted Radiation.

CLAIMS

1ª. DEVICE FOR TREATMENT AND DISINFECTION OF SOLIDS AND FLUIDS BY MEANS OF LASER RADIATION, of special application in the treatment and disinfection of the blood, liquids for human consumption and other uses, forages and flours, waters of swimming pools and irrigation, air conditioning, operating rooms and other enclosures, exteriors revetments cleaning and beer pasteurization, by radiation application Visible and/or Infrared in spaces closed and opened, for eliminate for heat the polluting mass, that it absorbs the radiation transmitted by the air and the mean to treat and that are constituted by means of laser generators and diverging lens, characterized essentially because the laser generator that transmits pressed or continuous radiation in the spectrum of wavelength λ between 0.38 and 1000 microns he presents adapted to his terminal compress a diverging lens (L) of variable opening and his radiation (R) is capable of affecting to a metallic element reflective (S) of semispherical form, conical or polygonal located in the bottom of a cavity, producing a multiplier effect of radiation.

2ª. DEVICE FOR TREATMENT AND DISINFECTION OF SOLIDS AND FLUIDS BY MEANS OF LASER RADIATION, according to the first claim, characterized because the diverging lens (L) of variable opening in accordance with surface to treat, is constituted by zinc selenide (ZnSe), or arsenide of gallium (GaAs), or fluorite (CaF2) or germanium (Ge), or quartz (SiO2) or other similar material.

3ª. DEVICE FOR TREATMENT AND DISINFECTION OF SOLIDS AND FLUIDS BY MEANS OF LASER RADIATION, according to the first one and second claim, in his application for microbiological treatment of liquids contained in the inside of one cavity, characterized because the cavity it is covered internally with a metallic plate (Lm) reflective of the radiation (R), of aluminum, copper, stainless steel or another similar material, that has in the bottom a reflective element (S) of semispherical form, conical or polygonal.

DRAWINGS

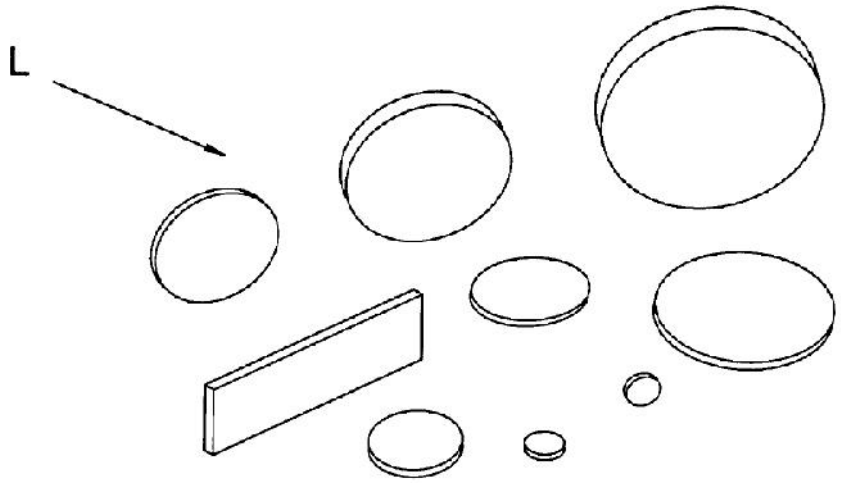

FIG. 1

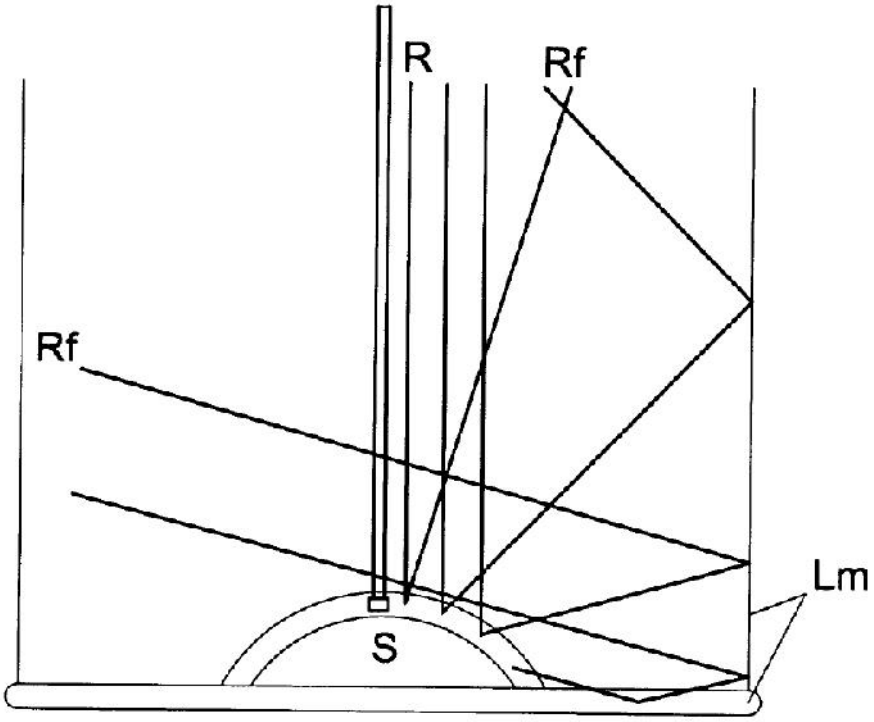

FIG. 2

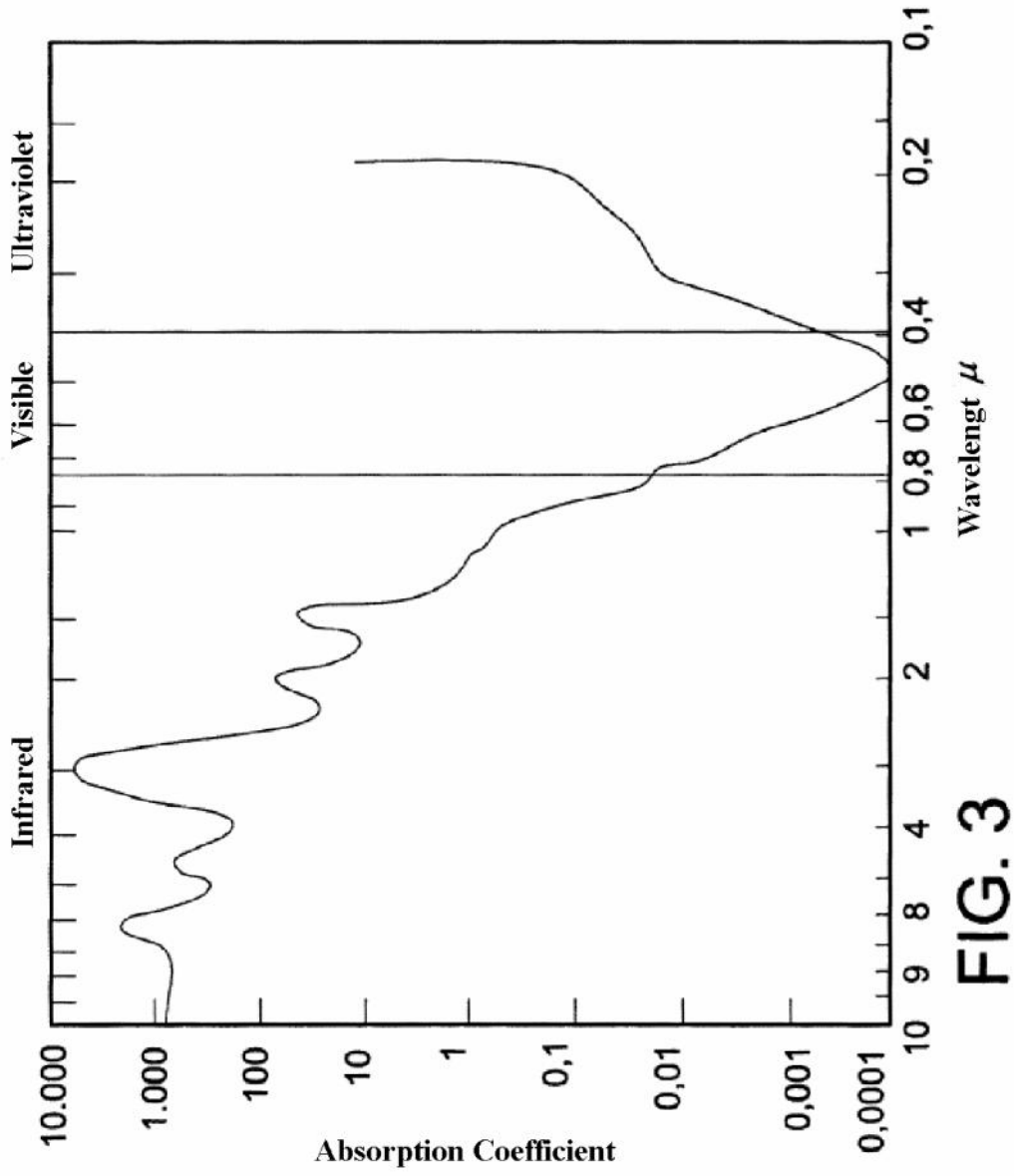
Infrared
Visible
Ultraviolet
10.000
1.000
100
10
1
0,1
0,01
0,001
0,0001
Absorption Coefficient
10
9
8
4
2
1
0,8
0,6
0,4
0,2
0,1
Wavelengt μ

FIG. 3

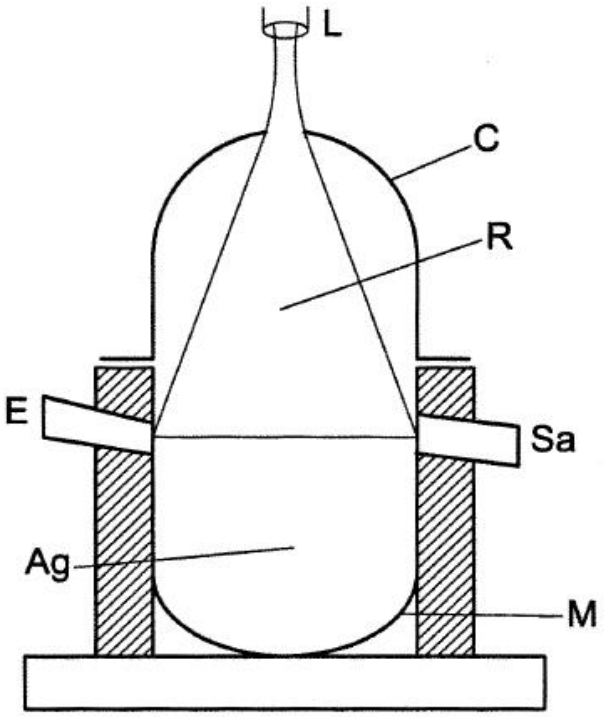

FIG. 4

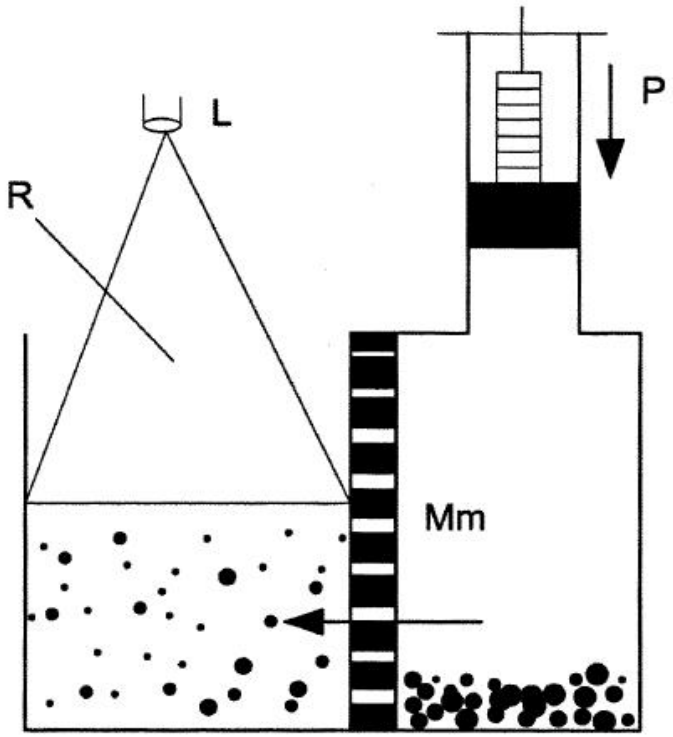

FIG. 5

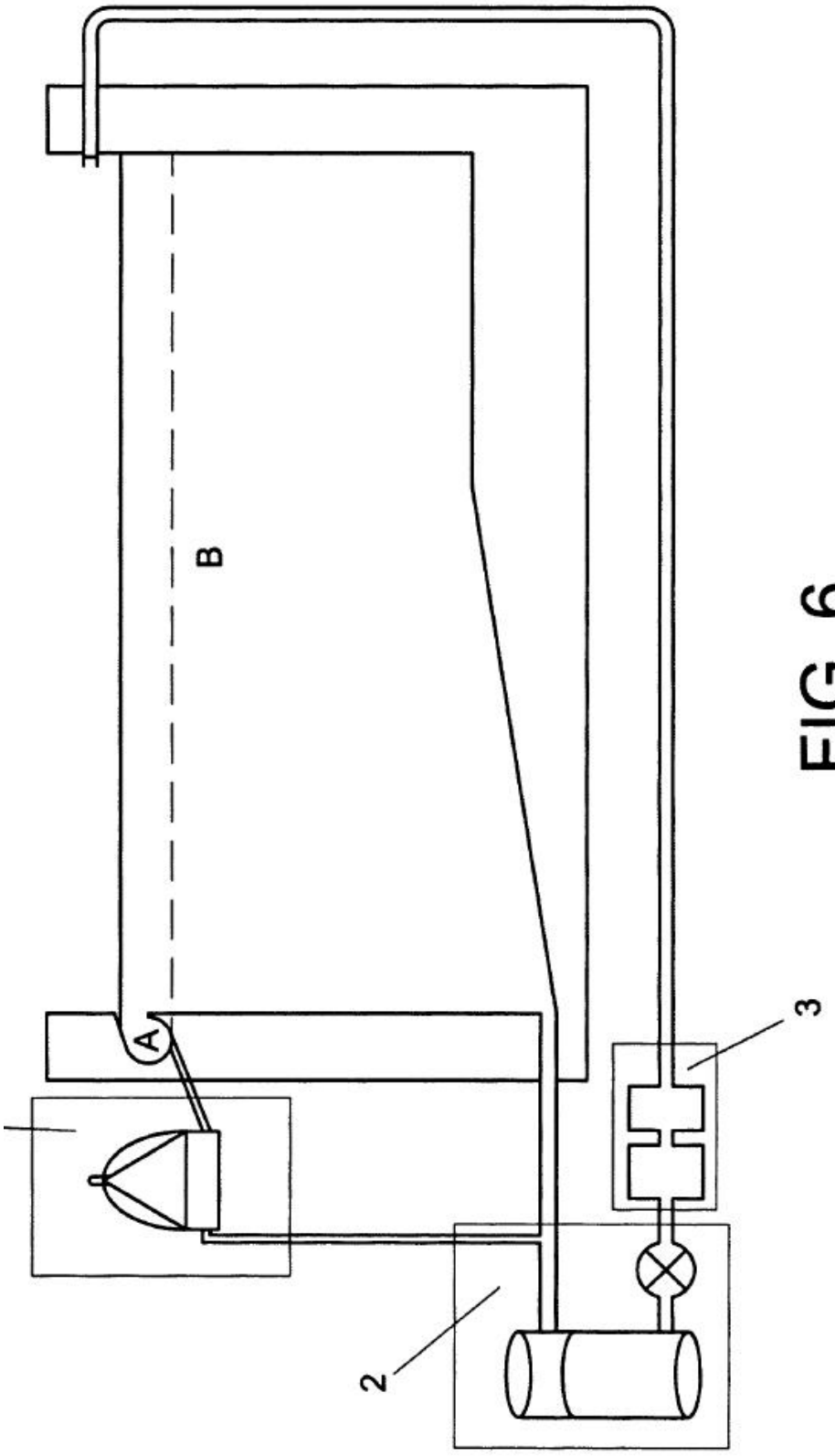

FIG. 6

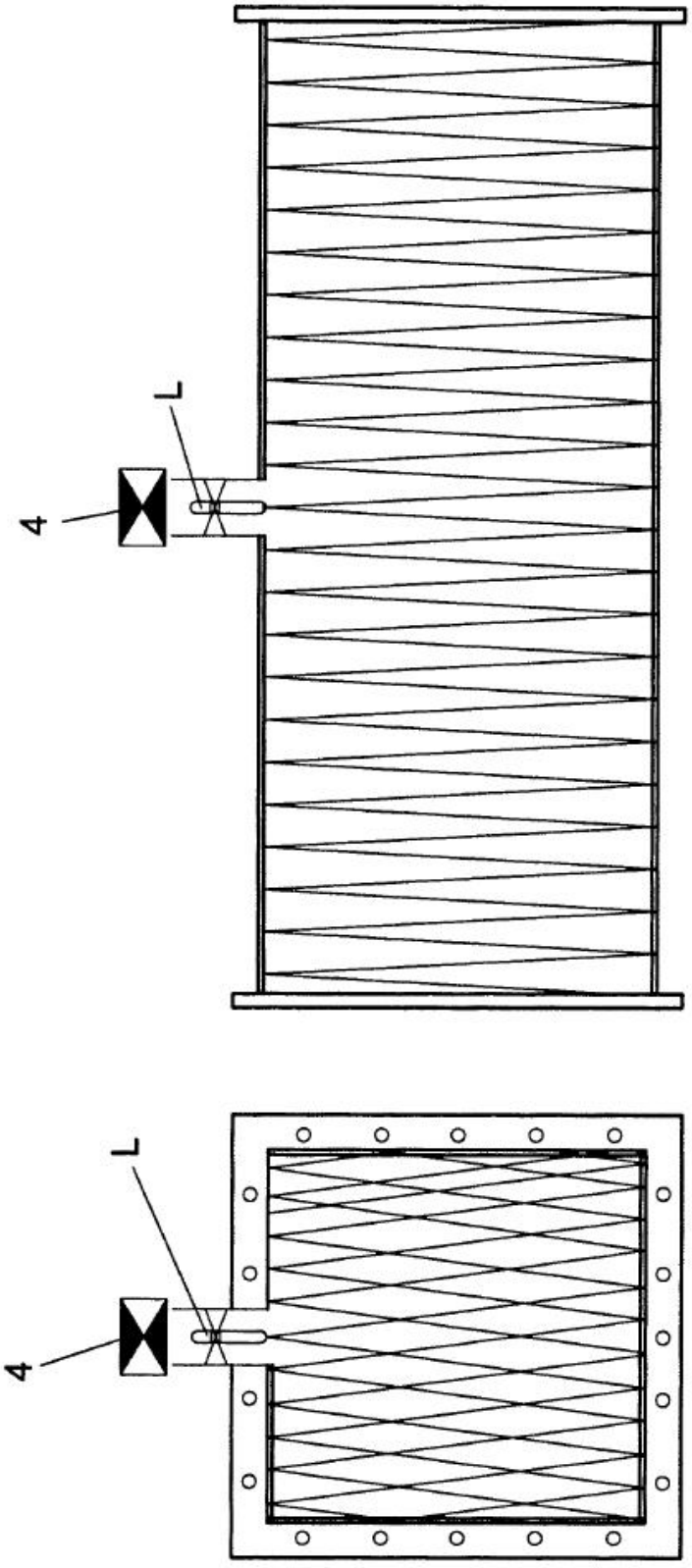

FIG. 7

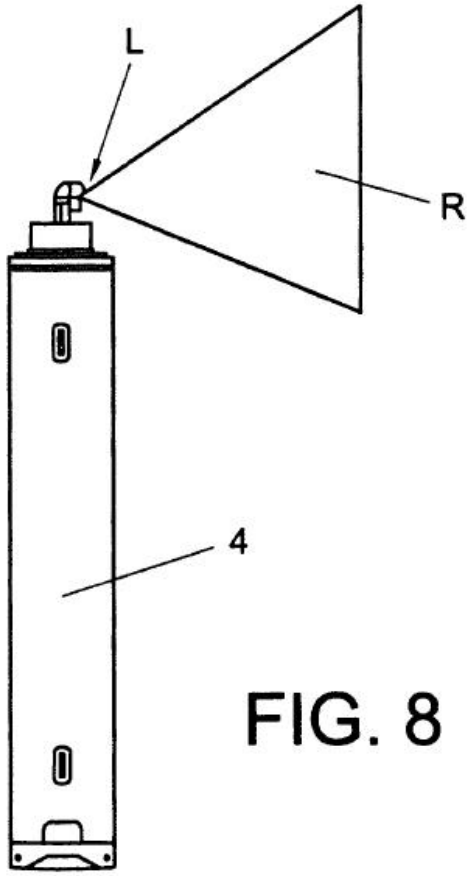

FIG. 8

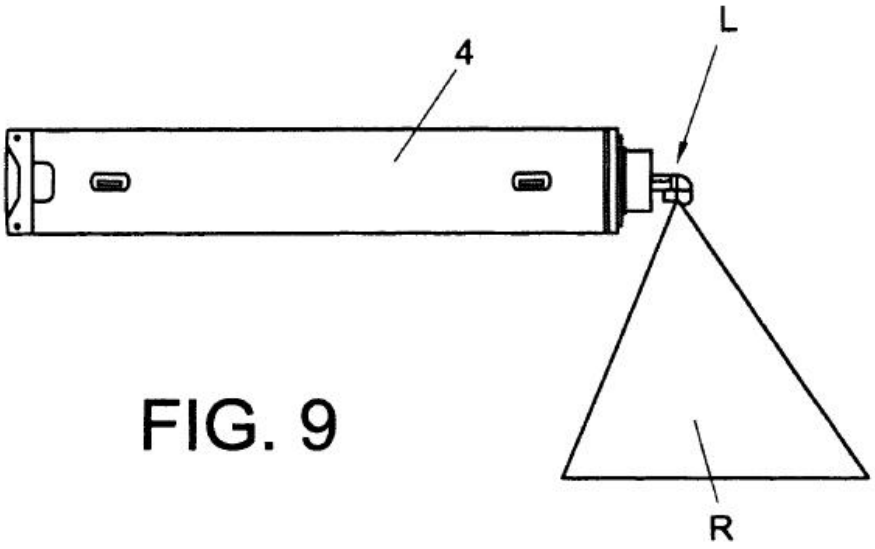

FIG. 9