Nov. 25, 1969 O. R. WALTRIP 3,480,529

ELECTRO-CHEMICAL METHOD FOR SELECTED DISSOCIATION

Filed Oct. 31, 1967 3 Sheets-Sheet 1

Fig. 1

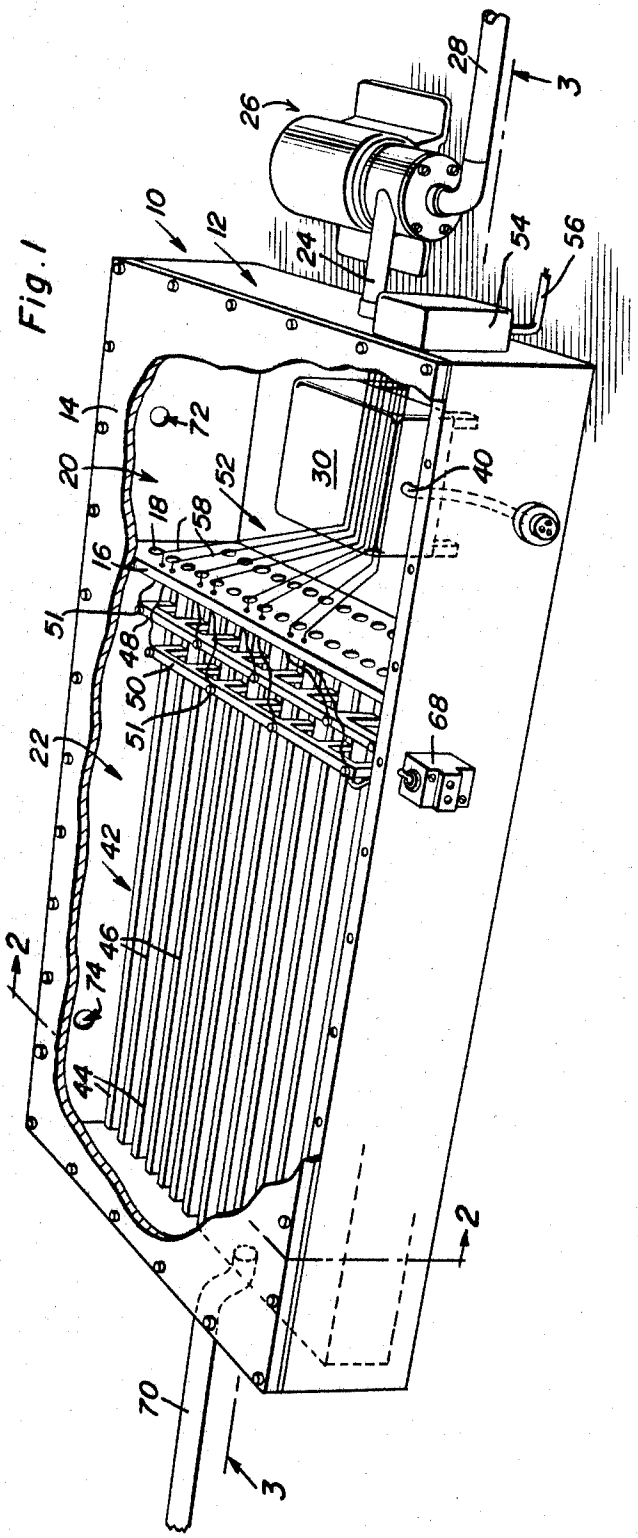
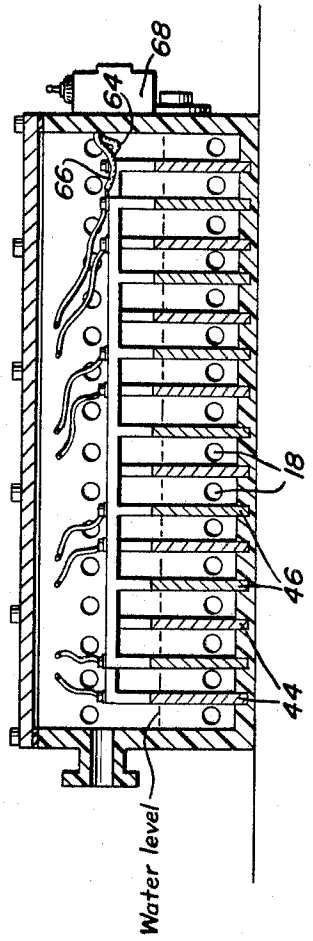


Fig. 2



Owen R. Waltrip

INVENTOR.

BY Clarence A. O'Brien and Harvey B. Jacobson

Attorneys

Nov. 25, 1969 O. R. WALTRIP 3,480,529

ELECTRO-CHEMICAL METHOD FOR SELECTED DISSOCIATION

Filed Oct. 31, 1967 3 Sheets-Sheet 2

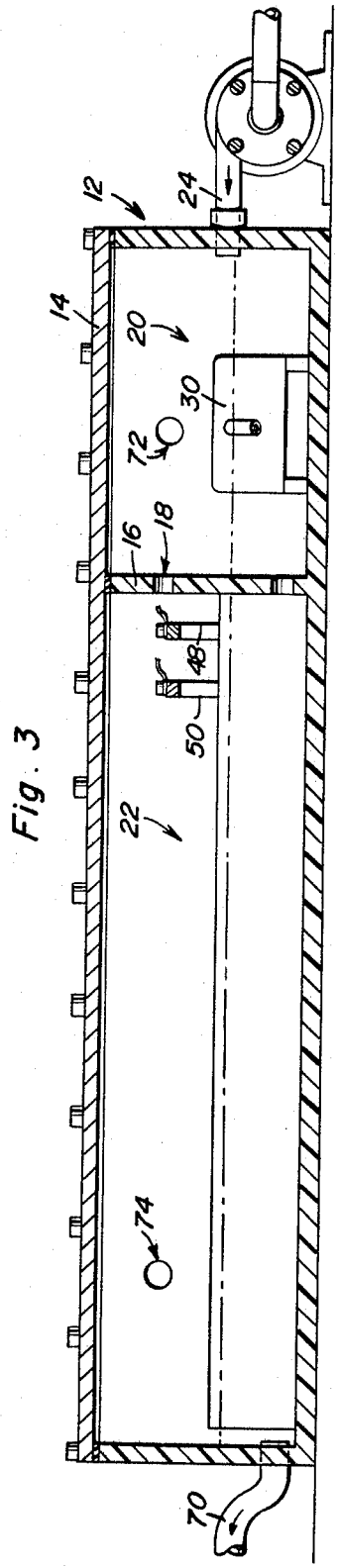


Fig. 3

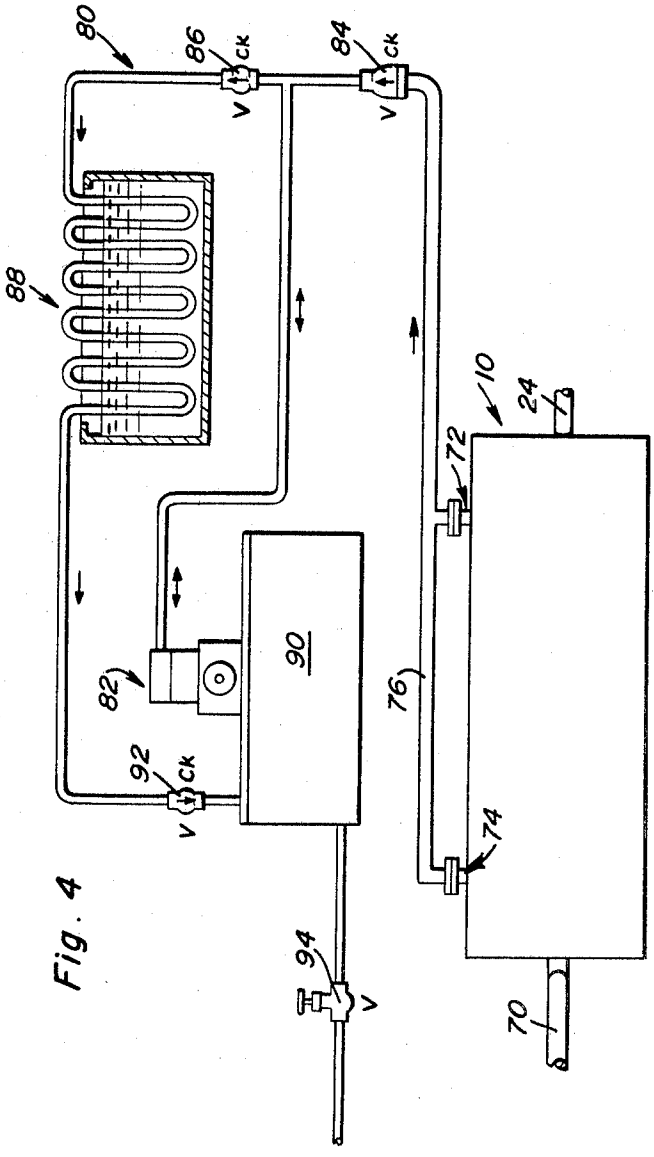


Fig. 4

Owen R. Waltrip
INVENTOR.

BY Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

Nov. 25, 1969 O. R. WALTRIP 3,480,529

ELECTRO-CHEMICAL METHOD FOR SELECTED DISSOCIATION

Filed Oct. 31, 1967 3 Sheets-Sheet 3

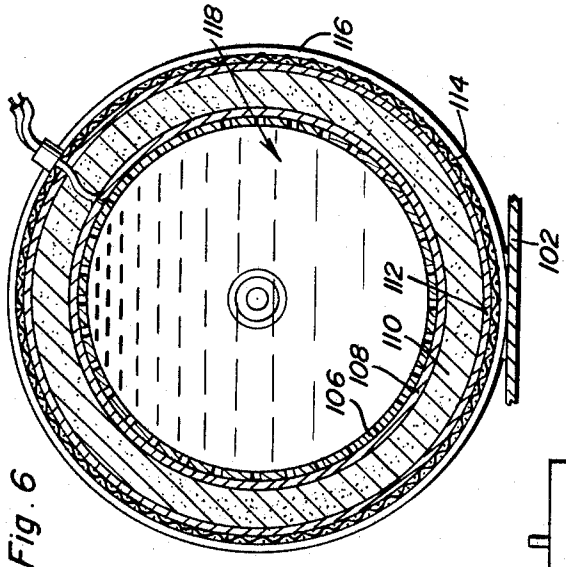


Fig. 6

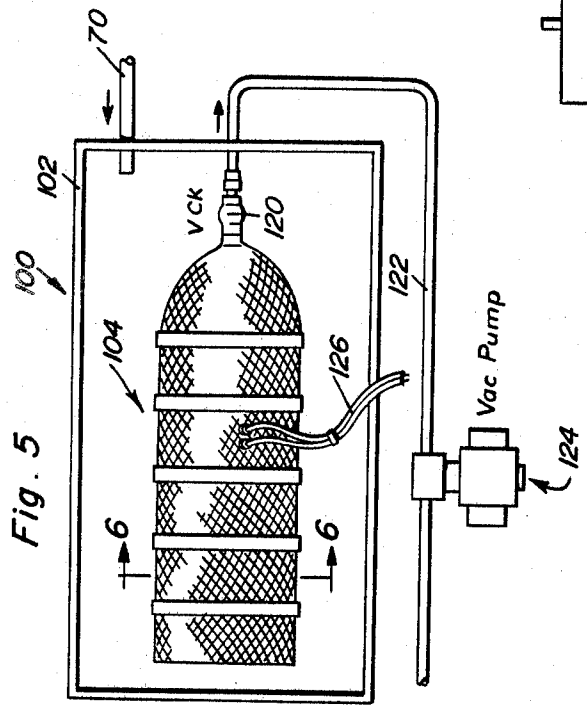


Fig. 5

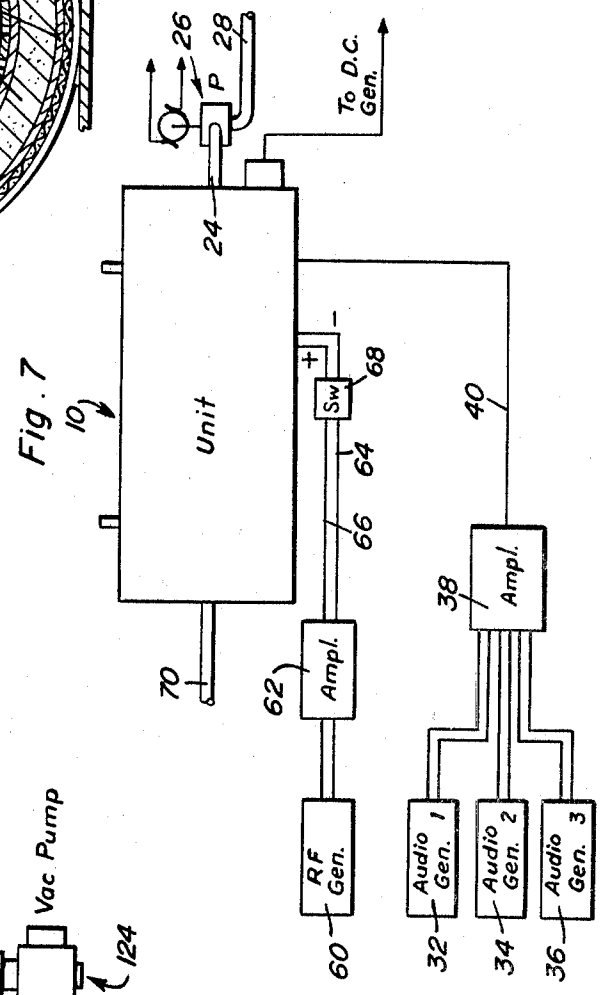


Fig. 7

Owen R. Waltrip
INVENTOR.

BY Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

United States Patent Office 3,480,529
Patented Nov. 25, 1969

3,480,529

ELECTRO-CHEMICAL METHOD FOR SELECTED DISSOCIATION

Owen R. Waltrip, Roseville, Calif., assignor of twenty-five percent to John Konsonlas, ten percent to Paul J. Lunardi, and ten percent to Willis Hampton, all of Roseville, Calif.

Continuation-in-part of application Ser. No. 497,044, Oct. 18, 1965. This application Oct. 31, 1967, Ser. No. 679,484

Int. Cl. C02b *1/82*; C01d *7/34*; B01k *1/00*

U.S. Cl. 204—130 9 Claims

ABSTRACT OF THE DISCLOSURE

A method for dissociating a medium within a treating zone to recover predetermined elemental components of the medium by establishing a D.C. potential within the treating zone, super-imposing oscillating electrical energy, at a radio frequency value, on the D.C. potential, and simultaneously imparting oscillating mechanical energy within the audio frequency range to the medium entering the treating zone for controlled dissociation of at least a portion of the medium to recover, and thus effectively remove, preselected elemental components of the medium.

This application is a continuation-in-part of application Ser. No. 497,044, filed Oct. 18, 1965, now abandoned.

This invention relates to a method, and an exemplary means, for dissociating chemical elements from a medium containing such elements in solution or suspension or consisting of compounds of such elements. More particularly, this invention relates to a method of utilizing an audio frequency harmonic tone having a predetermined rate of vibration selected on the basis of the chemical element or elements to be manipulated, in conjunction with an oscillating electrical energy input to the medium at a radio frequency value, preferably with the simultaneous utilization of a reaction promoting D.C. potential, within a treating zone containing the medium to be acted upon. The present invention therefore relates to a method of manipulating chemical elements by utilizing harmonic audio frequencies complementary to the harmonic "wave-energy picture," or more simply state, the harmonic audio frequency tones corresponding to those naturally radiating from and specific to each chemical element whereby chemical elements may be manipulated by utilization of such reproduced harmonic tones which corresponds in nature to thermally induced vibrations. Such thermally induced vibrations have been long recognized as influencing the rate of chemical reaction between chemical elements and compounds and has been theorized as directly related to the newly emerging interpretation by the scientific community of the harmonic wave energy aspect, or nature, of matter. Thus, the present invention relates to a method of utilizing combined audio and radio frequency energy, i.e. harmonic wave energy, to promote chemical reactions.

In my copending application referred to hereinbefore I dwell, at some length, on the theoretical aspects of my interpretation of the harmonic wave energy aspect, or nature, of matter. While it is not my desire to be restricted to the theory set forth at length therein, or briefly again touched upon herein, it will nevertheless be appreciated from the discussion following hereinafter that the present invention has as its primary object the provision of a novel method and means of relating the aforementioned theoretical considerations to the field of chemical processes and apparatus.

In this regard, it is another object of the present invention to provide practical applications of my novel

method by disclosing exemplary modes of the method such as for dissociating components in a predetermined medium within a treating zone, comprising a portion of an exemplary apparatus for carrying forth such a mode of my invention, whereby a D.C. potential is established within the treating zone, oscillating electrical energy at a radio frequency value, at a selected variable power input level, i.e., wattage is "superimposed" on the D.C. potential and mechanical energy at an audio oscillating frequency value is imparted to the medium entering the treating zone.

Exemplary embodiments set forth hereinafter to illustrate the carrying forth of the method of the present invention include the desalinization of saline water and the purification of domestic or industrial sewage wherein deleterious elemental components are dissociated from, and preferably recovered from, the medium being treated and wherein the liquid effluent from the treating zone is mechanically filtered in a filtering apparatus wherein an audio frequency is imposed to keep a filtering membrane therein free from dissociated elemental components carried over from the aforementioned primary treating zone thereby producing a final liquid effluent of a desired degree of purity.

A further object of the present invention is to provide a novel method for dissociating components in a predetermined medium within a treating zone wherein the medium entering the treating zone has imparted thereto an audio oscillating frequency of 256 cycles per second whereby in the treatment of exemplary liquid medium such as saline water, the utilization of such frequency in conjunction with the aforementioned oscillating electrical energy at a radio frequency value preferably in the presence of a D.C. ionizing potential effects the dissociation of elemental carbon, noble metals, iron and magnesium from the saline water.

Still another object of the present invention is to provide a novel method for dissociating elemental components from saline water so as to render the water suitable for agricultural use by imparting an audio oscillating frequency to the saline water entering a treating zone which audio oscillating frequency is the resultant of three audio input frequencies of 341⅓, 256 and 426⅔ cycles per second and wherein the aforementioned radio frequency value imposed on the treating zone is of selectively varied wattage whereby hydrogen, carbon dioxide and oxygen in a gaseous state may be separately and sequentially dissociated from the saline water and collected in the gaseous state for subsequent liquefaction, and elemental sodium, carbon and chlorine separately and sequentially collected by selectively varying the wattage of the radio frequency input.

Still a further object of the present invention is to provide a novel method for treating domestic and industrial sewage to bring about the purification thereof by the dissociation or degradation of organic substances therein to inorganic substances by the elimination of chemically combined carbon therefrom, and even including the destruction of viable dormant bacteria, by imparting an audio oscillating frequency consisting of the resultant of the aforementioned three audio input frequencies to sewage entering a treating zone wherein the oscillating electrical energy at a radio frequency value imposed on the sewage within the treating zone through positive and negative electrodes therein has its polarity reversed at a low rate.

Still a further object of the present invention is to provide an exemplary apparatus for carrying forth the aforementioned exemplary embodiments of the method of the present invention and wherein such apparatus is provided with auxiliary components adapted to facilitate the recovery of and subsequent liquefaction of gaseous com-

ponents evolved from the treating zone as well as an auxiliary filtering apparatus which utilizes radio frequency energy to augment filtration of liquid effluent from the primary treating zone.

These together with other objects which will become subsequently apparent reside in the method as more fully described hereinafter in conjunction with the apparatus illustrated in the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a simplified perspective view of an apparatus constructed in accordance with the principles of the present invention and primarily adapted for the treatment of a liquid medium further showing a portion of a gas-tight cover of the apparatus broken away to show the general organization of the major components within the interior of the apparatus.

FIGURE 2 is an enlarged vertical transverse cross-sectional view taken substantially along the plane of the line **2—2** of FIGURE 1;

FIGURE 3 is an enlarged longitudinal vertical cross-sectional view of the apparatus of FIGURE 1 taken substantially along the plane of the line **3—3** of FIGURE 1;

FIGURE 4 is a schematic illustration of an auxiliary gaseous component recovery means which may be utilized in conjunction with the primary treatment apparatus of FIGURE 1;

FIGURE 5 is a somewhat schematic view of an auxiliary or secondary, filtration means adapted to be operatively associated with the primary treatment apparatus of FIGURE 1.

FIGURE 6 is an enlarged cross-sectional view of the osmotic filter of the auxiliary apparatus of FIGURE 5 taken substantially along the plane of the line **6—6** of FIGURE 5; and

FIGURE 7 is a diagrammatic illustration of the major components of the exemplary liquid medium treating apparatus of FIGURE 1 and further showing means for generating the audio and radio frequencies required for the carrying forth of the method of the present invention.

Referring now to the drawings in greater detail, and FIGURES 1, 2 and 7 in particular, it will be seen that liquid medium treating apparatus indicated generally at **10** therein basically includes a generally fluid-tight tank **12** and a removable cover **14** sealingly secured to the tank **12** so as to provide a generally fluid-tight enclosure. The interior of the tank **12** is divided into two chambers by an apertured bulkhead **16** provided with a plurality of through apertures **18** to permit liquid medium introduced into a liquid medium pre-treatment zone **20** defined by the bulkhead **16** to flow into a liquid medium treating zone comprising a second chamber indicated generally at **22**. In a continuous processing form of the invention, liquid medium is supplied to the pre-treatment chamber **20** through a conduit **24** by a centrifugal pump means **26** receiving liquid medium to be treated through an intake conduit **28**. The pre-treatment chamber **20** is provided with a transducer means **30** adapted to operate within an audio frequency band to impart mechanical energy to the medium to be treated and which as seen best in FIGURE 7 receives an audio frequency input from one or more of three conventional audio frequency generators **32**, **34** and **36** preset to generate a harmonic frequency and operatively connected to an audio power amplifier **38** which is in turn connected to the transducer means **30** by a coaxial cable **40** which sealingly passes through a side wall of the tank **12**.

The treating chamber **22** is provided with a plurality of vertically disposed longitudinally extending spaced-apart negative and positive electrodes indicated generally at **42** and consisting of alternately disposed generally negative electrodes **44** such as formed of lead and generally positive electrodes **46** such as formed of stainless steel. The negative electrodes **44** are connected in parallel by a negative electrode bus bar **48** and the positive electrodes **46** are connected in parallel by a bus bar **50**. The bus bars **48** and **50** are energized by imposing D.C. potential thereon through suitable conductor means indicated generally at **52** extending from a terminal box **54** receiving a D.C. potential input from a suitable generator, not shown, through cable **56** and wherein, as seen best in FIGURES 1 and 2, the conductor means **52** comprises a plurality of paired conductors **58** connected at a plurality of points **51** to the respective bus bars **48** and **50** so as to obtain relatively uniform current distribution. The bus bars **48** and **50** are also conductively connected to the output of a radio frequency generator **60** through a radio frequency amplifier **62** connected by lead wires **64** and **66** to the bus bars **48** and **50** through reversing switch means **68**. The output energy level of the radio frequency amplifier **62** is relatively high as compared to the output of the audio frequency amplifier **38**.

The tank **12** is further provided with a discharge outlet **70** in communication with the treating chamber **22** and wherein the height of the outlet conduit **70** assists in maintaining the maximum level of liquid medium within the treating chamber **22** somewhat below the top of the electrodes **44** and **46**, such as indicated in FIGURE 2. From a simultaneous consideration of FIGURES 1 and 4 it will be seen that the chambers **20** and **22** are provided with gas outlets **72** and **74**, positioned well above the maximum level of liquid within the tank **12**, which gas outlets are connected by a common header **76** to an auxiliary gaseous product recovery means indicated generally at **80** which includes a compressor means **82** which intakes gaseous components from the header **76** on an intake stroke through a one-way check valve **84**. On its discharge compression stroke, the compressor forces the condensed gaseous components through a one-way check valve **86** to a high pressure gas condensing means **88** wherein the high pressure gaseous components are condensed to a high pressure liquid which liquid is conveyed to a liquid gas storage tank **90** through a one-way check valve **92** and from which storage tank **90** liquefied gas may be withdrawn as desired by means of a valve means **94**.

Now further considering FIGURE 1 in conjunction with FIGURES 5 and 6 it will be seen that the discharge conduit **70** which conveys the effluent from the treating chamber **22** may be provided with an auxiliary filtration means indicated generally at **100** which basically comprises an enclosed tank **102** receiving liquid effluent from the conduit **70**. The filtration unit **100** generally comprises a secondary filtration means for the liquid effluent of the treating chamber **22**. Toward this end, the filtration unit **100** has operatively positioned within the tank **102** thereof an osmotic membrane filter means indicated generally at **104** which filter includes a perforated stainless steel cylinder **106** having an osmotic membrane **108** secured to the exterior thereof and including an annular cylinder of sharp clean filtering sand **110** interposed between the osmotic membrane **108** and a second osmotic membrane **112**. The osmotic membranes and sand are secured to the stainless steel cylinder **106** by a diamond pattern steel mesh fabric **114** secured by a plurality of support bands **116**.

The interior **118** of the stainless steel tank **106** is connected through a one-way check valve **120**, and conduit **122** to a vacuum pump means indicated generally at **124** which assists in reducing the relative pressure between the interior of the tank **106** and the interior of the tank **102** so as to enhance the passage of liquid medium from within the tank **102** through the osmotic membranes and filtering sand **110** into the interior **118** of the tank **106** as will be discussed in greater detail hereinafter. In addition, the steel mesh **114** is connected by suitable conductors **126** to the radio frequency generator **60**.

The exemplary apparatus briefly discussed hereinabove may be utilized for the selected dissociation of innumerable liquid mediums and merely for the sake of brevity

the discussion hereinafter with regard to the utilization of the above apparatus for the carrying forth of the method of the present invention will be restricted to the utilization thereof for the separate treatment of two liquid mediums consisting of saline water, i.e., sea water, and industrial or domestic sewage. In addition, the treatment of saline water will be discussed with regard to the separate and sequential recovery of hydrogen, carbon dioxide and oxygen gases as well as elemental sodium, carbon and chlorine and alternatively for the simultaneous dissociation of elemental carbon, noble metals, iron and magnesium from saline water and the compounds therein. Furthermore, the discussion of the method of the present invention with regard to the treatment of industrial or domestic sewage centers primarily around the dissociation of organic compounds which it will be appreciated comprise the greatest proportion of contaminants in sewage and wherein for purposes of discussion herein viable organisms such as bacteria, and even including viable dormant bacteria are subjected to dissociation and thus irreversible destruction. Thus, the discussion of the utilization of the apparatus is intended to specifically set forth exemplary modes of carrying forth the method comprising the present invention.

EXAMPLE I

In this example, the apparatus described hereinabove is utilized for the dissociation of hydrogen, carbon dioxide, oxygen and chlorine in a gaseous state and the dissociation of sodium, and carbon which are collected as solids. In this regard, saline water, such as sea water, is introduced into the tank **12** and thus the compartments **20** and **22**, to a level somewhat below the top of the electrodes **44** and **46** which level is generally determined by the configuration of the effluent conduit **70**. At this point, and as will best be appreciated from a simultaneous consideration of FIGURES 1 and 7, audio generators **32**, **34** and **36** are individually energized at 341⅓, 256 and 426⅔ cycles per second respectively which three audio frequencies generated comprise the input to the audio amplifier **38**, having a power output range of 1 to approximately 1000 watts, and wherein the aforementioned three separately generated audio frequencies are combined whereby the amplifier **38** has a resultant beat pulse output frequency of 384 cycles per second which is fed to the transducer **30**. The transducer **30** when intended for operation in a power range of 1 to approximately 20 watts most generally is of the crystal type and when intended for operation in a power amplification range of 1 to approximately 1000 watts is generally a fully transistorized type. Thus, upon energization of the transducer **30** in the aforementioned manner mechanical energy at a beat pulse frequency value of 384 cycles per second is imparted to the saline water within the pretreatment chamber **20**. Simultaneously, a D.C. potential is applied to the negative and positive electrodes **44** and **46** respectively which potential is of a current density conventionally utilized in electrolytic cells. To complete energization of the treating apparatus **10** the radio frequency generator **60** is energized and the output thereof amplified in the radio frequency amplifier **62** which is also applied in a polarized manner to the bars **48** and **50**. The power output of the amplifier can be as high as 100,000 watts. It will be understood that the method of the present invention can be carried forth at a preferred, optimum radio frequency requiring a relatively lower power output of the radio amplifier **62** than when the apparatus **10** is operated at another less suitable but nonethe-less operative radio frequency. In this regard, the preferred radio frequency for this example is 80 megacycles. However, since this frequency is within a band allocated to the United States Marine Corps, the actual tests were conducted at approximately 27 megacycles which it will be appreciated is within a less stringently regulated citizen's band. As discussed hereinabove, the output of the amplifier **62** is fed to the bus bars **48** and **50** by means of their respective leads **64** and **66**. Due to the variable composition of the saline water being introduced by the pump means **26** the power output of the radio amplifier **62** is empirically determined by gradually increasing the power output until conventional analytical chemical monitoring of the gaseous effluent of the treating zone **22** discharging through the outlet **74** indicates the presence of the initial component to be dissociated which in this instance generally comprises hydrogen gas. It will thus be seen that the saline water energized at a pulse beat audio frequency of 384 cycles per second in the pre-treating zone **20** passes through the apertures **18** in the bulkhead **16** wherein the mechanically energized saline water travels downwardly between the respective electrodes **44** and **46** and the combined effect of the audio frequency energy imparted to the water in chamber **20** which it is theorized is somehow "coupled" with the radio frequency imparted to the liquid medium traveling through the treating zone **22** effects dissociation of the liquid medium whereby the potential established between the electrodes **44** and **46** acts to collect the respective components dissociated. As indicated hereinabove the hydrogen, for example, is evolved in a gas fraction for subsequent collection, compression and condensing in the apparatus **80**. Furthermore, as the power output of the radio amplifier **62** is increased and monitoring of the system indicates that the desired component has become dissociated, the power amplification of the radio frequency input to the treating zone **22** is maintained at a constant level while the volume of saline water being introduced to the pretreatment zone **20** by the pump **26** is maintained at uniform flow whereby monitoring of the liquid medium in the treating zone **22** by an electrical meter, not shown, indicates that a minimal potential is present in the treating zone. It will be appreciated that the presence of a minimal potential indicates that there is a nearly complete removal of elements from the saline water that permit the establishment of the potential between the respective electrodes **44** and **46**.

It will be apparent that the treating apparatus **10** is preferably operated in a continuous manner. However, it will also be appreciated that if so desired the treating apparatus **10** could be operated in a batch manner wherein subsequent to loss of conductivity in the treating zone **22** the liquid therein would be drained and replaced by additional amounts of liquid medium to be treated introduced through the pre-treatment zone **20**.

Liquid effluent leaving the treating zone **22** through the conduit **70** may if desired be subjected to the auxiliary filtration apparatus **100** wherein the diamond steel mesh **144** has a radio frequency value imposed thereon, it having been found unnecessary to reapply the pulse beat audio frequency which is carried over in the liquid medium so as to keep the outer membrane **112** free from any sludge carried over and repel sodium and chlorine whereby only pure water passes through to the interior **118** of the steel cylinder **106**. The vacuum pump means **124** accordingly withdraws purified water from the interior of the tank **106**.

EXAMPLE II

The method set forth in Example I was again carried forth utilizing saline water as the medium to be treated with the exception that the treatment was for the dissociation of the colloidally dispersed noble metals consisting of gold, silver, mercury, platinum, palladium, iridium, rhodium, ruthenium and osmium, as well as iron and magnesium and to effect dissociation of carbon, therefore bringing about the degradation of any organic compound in the saline water. In carrying out the dissociation of this example the audio frequency input to the transducer **30** consists solely of the output of audio generator **34**, which as indicated heretofore, generates a harmonic audio frequency of 256 cycles per second. The over-all operation of the treating apparatus **10** and the ancillary

treating means **80** and **100** was the same as set forth with regard to Example I.

EXAMPLE III

In still another test involving the utilization of the treating apparatus **10** to carry forth the method of the present invention substantially untreated sewage, comprising a mixture of industrial and domestic sewage obtained from a municipal sewage plant, was treated by introducing the sewage into the pre-treatment chamber **20** wherein mechanical energy was imparted thereto by subjecting the influent to a resultant beat pulse of 384 cycles per second to the transducer **30** which beat pulse was a resultant of the combined outputs of audio generators **32**, **34** and **36** operating at 341⅓, 256, and 426⅔ cycles per second respectively combined into a beat pulse and amplified by the audio frequency amplifier **38**. As in Example I, the negative electrodes **44** and positve electrodes **46** had a D.C. potential applied thereacross through the paired leads **58** operatively and conductively connected to a source of D.C. current as discussed hereinabove and wherein the positive lead **66** of the radio frequency amplifier **62** was connected to the bus bar **50** and the negative lead **54** from the radio frequency amplifier **62** connected to the bus bar **48**. For test purposes only a frequency of 27 megacycles was used. From the foregoing it will be seen that the operation of the treating apparatus **10** for the treatment of sewage is substantially the same as that utilized in Example I for the treatment of saline water for the desalinization thereof and/or separate recovery of several other components thereof. However, to effect dissociation of the organic compounds, i.e. the bulk of the contaminants in sewage and including viable dormant bacteria, the radio frequency polarity reversing switch operatively interposed in the output leads **64** and **66** of the radio amplifier **62**, is utilized to reverse the polarity of the radio frequency energy applied to the bus bars **48** and **50**, and thus the electrodes **44** and **46**. The reversing was carried out at a low rate, i.e., a few times per minute, whereby the liquid effluent leaving the treating zone **22** through the discharge conduit **70** had an exceptionally low B.O.D., only a trace of settleable solids and actually exhibited an increase in dissolved oxygen apparently due to liberation of oxygen from the organic compounds dissociated. The effluent also had an extremely low density of coliform organisms per unit of effluent. It will be appreciated of course that with the utilization of a relatively simple treating apparatus as shown herein the device would of necessity have to be shutdown periodically to remove the carbonaceous precipitate resulting from the dissociation of the organic compounds, which precipitate will eventually bring a halt to the dissociation action within the treating zone **22**. When treating sewage in the aforementioned manner, it has also been found to be desirable to operate the ancillary harmonic frequency-osmotic filter means **100** to insure removal of any minute amounts of sludge, i.e. carbonaceous material, carried over from the primary treating zone **22**. In such case, the harmonic frequency-osmotic filter means **100** is operated substantially as set forth hereinabove to effect final filtration of the effluent of the primary treating zone **22**.

Thus, from the foregoing it will be understood that the method of the present invention apparently permits the coupling of a key harmonic frequency or key harmonic frequencies to a radio frequency carrier in a liquid medium simultaneously subjected to a D.C. potential wherein the dissociation of elemental components contained in the liquid medium may be readily effected.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A method for dissociating components in a predetermined medium within a treating zone comprising the steps of: establishing a D.C. potential within the treating zone; superimposing oscillating electrical energy on said potential at a radio frequency value; and imparting mechanical energy to the medium entering the treating zone at an audio oscillating frequency.

2. The method of claim **1** wherein said audio oscillating frequency is 256 cycles per second.

3. The method of claim **1** wherein said audio oscillating frequency is the resultant of three audio input frequencies of 341⅓, 256 and 426⅔ cycles per second.

4. The method of claim **1** including the step of: reversing the polarity of said potential relative to the superimposed electrical energy at a rate less than the audio frequency of the mechanical energy.

5. The method of claim **1** including the step of withdrawing gases released in the treating zone from the medium.

6. The method of claim **5** wherein said audio oscillating frequency is 256 cycles per second.

7. The method of claim **5** wherein said audio oscillating frequency is the resultant of three audio input frequencies of 341⅓, 256 and 426⅔ cycles per second.

8. The method of claim **1** including the step of filtering the medium after withdrawing from the treating zone.

9. The method of claim **8** including the step of: reversing the polarity of said potential relative to the superimposed electrical energy at a rate less than the audio frequency of the mechanical energy.

References Cited

UNITED STATES PATENTS

2,085,711	6/1937	Biesinann.	
2,585,103	2/1952	Fitzgerald	210—19 X
2,861,932	11/1958	Pohl	204—273 X
2,907,455	10/1959	Sasaki	210—19 X
3,109,721	11/1963	Zenner et al.	210—19 X
3,206,397	9/1965	Harvey	210—19
3,266,631	8/1966	Snaper	210—19 X
3,294,666	12/1966	Wiersma	204—228
3,305,481	2/1967	Peterson	210—19

ALLEN B. CURTIS, Primary Examiner

U.S. Cl. X.R.

204—149, 152, 273; 210—19