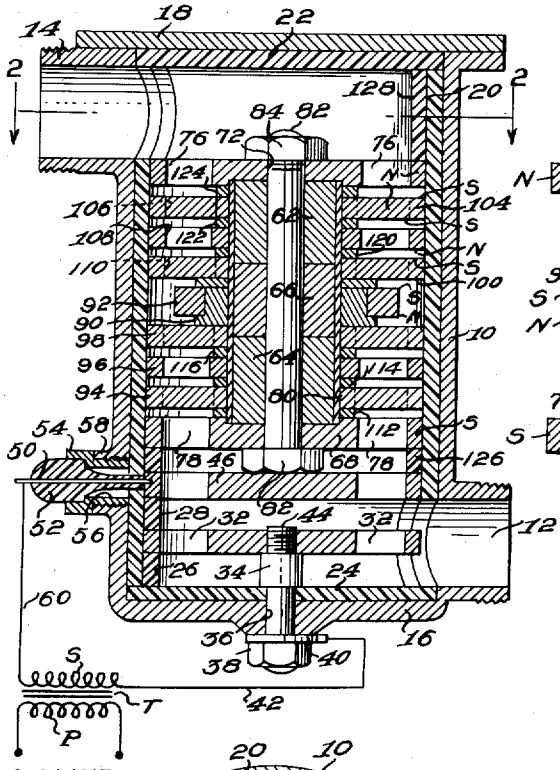
July 17, 1962 SABURO MIYATA MORIYA ET AL Re. 25,201

APPARATUS FOR THE IONIZATION OF ELECTRONS OF FLOWABLE MATERIALS

Original Filed June 2, 1959

Fig. 1.



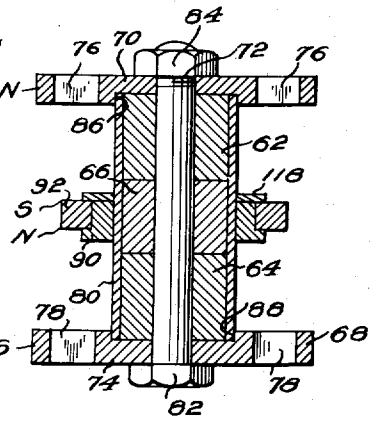


Fig. 3.

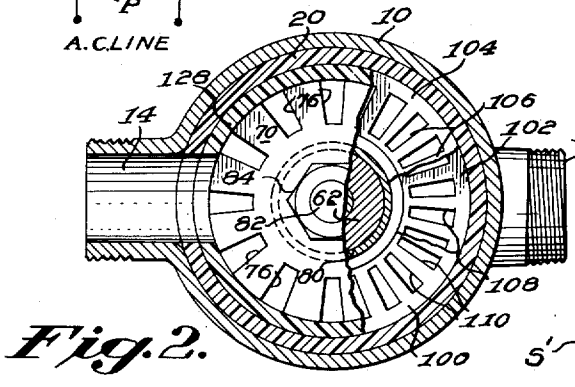


Fig. 2.

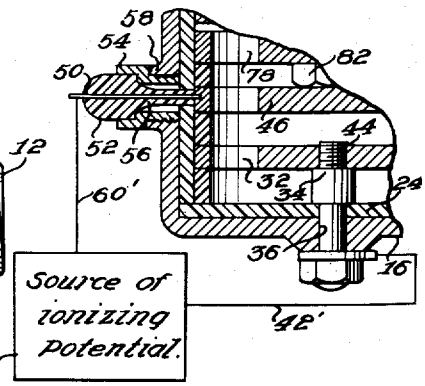


Fig. 4.

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APPARATUS FOR THE IONIZATION OF ELECTRONS OF FLOWABLE MATERIALS

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10 Claims. (Cl. 313—153)

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This invention relates to an apparatus to intensify the ionization of electrons of flowable materials, particularly liquids, or gases.

In the purification of liquids, particularly water, they are sometimes subjected to electric ionization.

One object of this invention is the provision of means for intensifying the ionization of liquids or gases.

A further object of this invention is the provision of means wherein fluids or gases are subjected to a series of strong magnetic fields.

Another object of this invention is the provision of apparatus wherein the fluids or gases are subjected to the ionizing effect of electric currents passing therethrough.

An additional object of this invention is the provision of means for intensifying the ionization of fluids or gases wherein the fluids or gases are subjected to the effects of an electric ionization current, preferably high or low tension of negligible capacity (voltage of which is in relation to the conductivity of the flowable material) and then to the effect of strong magnetic fields.

These and other objects will become apparent from a consideration of the following specification taken with the accompanying drawings forming a part thereof.

In the drawings:

FIG. 1 is a vertical section through a preferred form of our device;

FIG. 2 is a part sectional plan view taken on the line 2—2 of FIG. 1 and showing parts broken away;

FIG. 3 is a vertical section of a portion of the magnetic apparatus; *and*

FIG. 4 is a fragmentary view similar to FIG. 3 showing the use of any well known source of ionizing potential such as a generator, a battery or a transformer as in FIG. 1.

Referring now to FIGS. 1 and 2, a preferably cylindrical casing **10**, having an inlet **12** adjacent one end and an outlet **14** adjacent the other end, is preferably formed of non magnetic and non corrodible material such as brass aluminum or 18–8 stainless. If cost be a factor, soft iron may be used for the casing **10**, as the arrangement of magnets used herein have very little flux leakage. The casing **10** has an integral bottom **16** and a cover **18** suitably attached thereto. Within the casing **10** we provide an insulating cylindrical liner **20** and upper and lower end liners **22** and **24**, respectively, such liners being formed of suitable inert plastic material.

A pair of insulating spacer rings **26**, **28**, placed in the lower or inlet end of the casing **10**, retain a disc **30** having annularly spaced openings **32** therein. A stud **34** passes through an opening **36** in the bottom **16**, and is threaded at its lower end for a nut **38**. A washer **40**, connected by means of a line **42** to the secondary S of a step up or step down transformer T, is clamped under the nut **38**. The upper end of the stud **34** is threaded at **44** into the disc **30**. The disc **30** thus becomes one terminal, preferably the grounded terminal, of an alternating current supply. The other terminal of

the secondary S is connected to a metallic disc **46** having annularly arranged perforations **48** therein. A suitable conductor **50** is connected to the disc **46** and passes through an insulating bushing **52** mounted in a sleeve **54** threaded in an opening **56** in a boss **58** mounted in the side of the casing **10**. The conductor **50** is connected by means of a line **60** to the secondary S of the transformer T. The primary P of the transformer T is connected to an A.C. line supplied with commercial voltage.

Fluids entering the inlet **12** flow around and through the discs **30** and **46** and are subjected to the ionizing effect of the A.C. potential applied to these two discs, gaps of which are adjustable in relation to the voltage employed and material passing therethrough.

As shown in FIG. 4, the source of ionizing potential need not be the transformer T, but may be any suitable well known source S', such as a battery, a generator or a step-up or step-down transformer. The wire 42' connects one side of the source S' to the terminal 50 and the wire 42' connects the other side of the source S' to the washer 40, as described above.

To further intensify the ionization effect, we provide a magnet structure including a pair of axially spaced tubular magnets **62**, **64**, a tubular spacer **66** of paramagnetic material and a pair of pole pieces **68**, **70** of soft iron or other suitable paramagnetic material, having openings **72** and **74**, respectively, therein. The discs **68** and **70** are provided respectively with annularly arranged openings **76**, **78**. A sleeve **80** surrounds the magnets **62**, **64** and the spacer **66**, and the whole assembly is held together by means of a bolt **82** and nut **84**. The pole pieces **68** and **70** preferably have counter bores **86** and **88** respectively therein, to accommodate the sleeve **80** and the ends of the magnets **62**, **64**.

Intermediate the ends of the magnet assembly we place a spacer of non magnetic material **90** and mount thereon a ring magnet **92**, used as concentrator. On the magnet assembly are placed also a series of magnetic grids **94**, **96**, **98**, **100**, **102** and **104**, each having an annular series of openings therein, such as **106** in grid **104**; **108** in grid **102**; **110** in grid **100** etc. As is clearly shown in FIG. 2, the openings **106**, **108**, **110** etc. in the grids **104**, **102**, **100** etc. are staggered with respect to each other.

The grids **94**, **96** and **98** are spaced by means of spacers **112**, **114** and **116** from the pole piece **70** and from each other. Spacer **90** rests on grid **98** and a spacer **118** rests on the spacer **90** to separate the magnet **92** from the grid **100**. Grids **100**, **102** and **104** are separated by spacers **120** and **122**, and a spacer **124** separates grid **104** from the pole piece **68**. The spacers **90** and **112** to **124** are of non magnetic material.

The whole magnetic assembly **62**—**124** above described rests on a spacer **126** of insulating material and a spacer ring **128** of insulating material fills the space between the magnet assembly and the cover plate insulator **22**. The magnets **62**, **64** and **92** are preferably formed of very high permeability alloys and provide, between the pole pieces **68** and **70**, a field of intense magnetic flux. If desired, grids **94**, **96**, **98**, **100**, **102** and **104** may be omitted.

The use of the spacers as described above causes each grid to have its own N. and S. polarity as shown in the drawings by the letters "N." and "S.".

By the use of spacers **26** and **28** of different axial dimensions the spacing between the plates **30** and **46** may be varied.

In use, fluid entering the casing in inlet **12** are first subjected to the potential between the plates **30** and **46** to effect ionization. The ionization is further intensified

by the strong magnetic flux in the space between the pole pieces **68** and **70** as the fluid passes in a tortuous path through the magnetized grids **94**, **96**, **98**, **100** and **104** on its way to the outlet **14**.

We claim:

1. In a device for increasing the ionization of fluids comprising a substantially cylindrical casing having an inlet at one end and an outlet at the other end, a pair of spaced electrodes adjacent the inlet for applying an [A.C.] ionizing potential, means in said casing spaced from said electrodes, for producing an area of strong magnetic flux; said means comprising a magnet assembly including a magnetic core and a pair of spaced pole pieces and shielding means for said core; means in said flux area for producing a tortuous path for fluids passing from the inlet to the outlet.

2. The structure as defined in claim 1 wherein said spaced electrodes comprise a pair of spaced discs insulated from each other, and including a transformer having its secondary connected to said discs.

3. The structure as defined in claim 1 wherein the magnetic core comprises a pair of spaced apart tubular magnets of high permeability alloy, a spacer of paramagnetic material between said magnets and means securing said magnets, said spacer, said shield and said pole pieces together.

4. The structure as defined in claim 3 including a ring magnet height of which is less than the spacer intermediate said pole pieces and spaced from said shield.

5. The structure as defined in claim 4 including a plurality of grids of paramagnetic material in the flux area between said pole pieces, said grids being spaced from each other and said pole pieces, and each comprising a disc having N. and S. poles.

6. The structure as defined in claim 5 wherein the polarity of each of said magnets and each disc is in the same direction relative to the direction of flow of fluid.

7. The structure as defined in claim 1 wherein the core means for producing an area of strong magnetic flux comprises high permeability magnet and a pair of disc pole pieces affixed thereto.

8. The structure as defined in claim 7 wherein the means causing the fluid to follow a tortuous path comprises a plurality of spaced discs of paramagnetic material axially arranged between said pole pieces.

9. The structure as defined in claim 8 wherein the pole pieces and the discs have openings therein for the passage of fluids.

10. The structure as defined in claim 9 wherein the openings are annularly spaced and staggered from disc to disc.

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