March 2, 1954 J. F. LEDERER 2,671,200

SAFETY SIGNAL DEVICE

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Fig. 1.

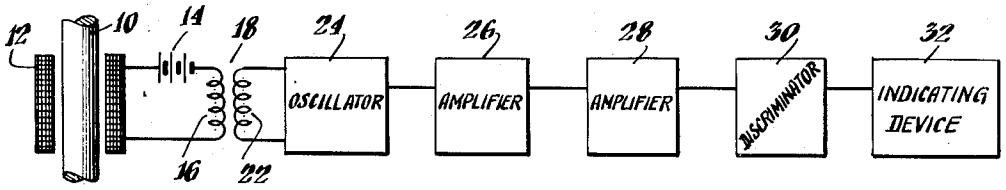


Fig. 2.

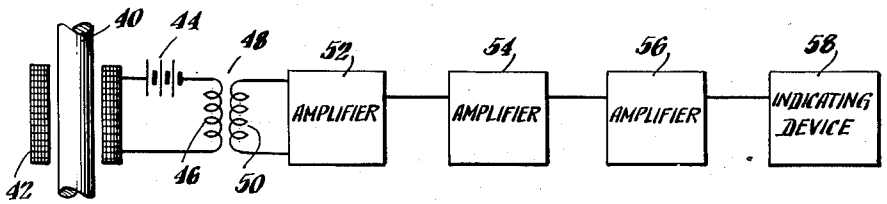
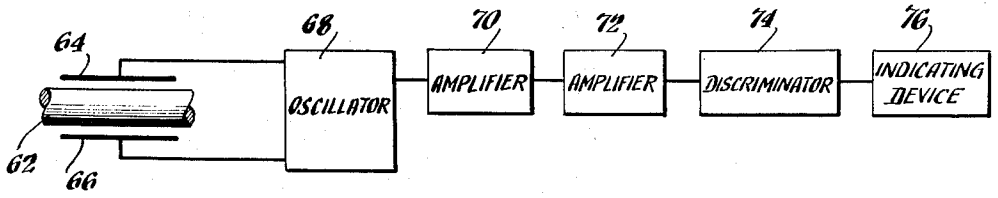


Fig. 3.



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Fig. 4

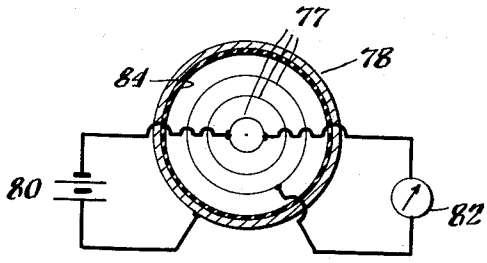


Fig. 5

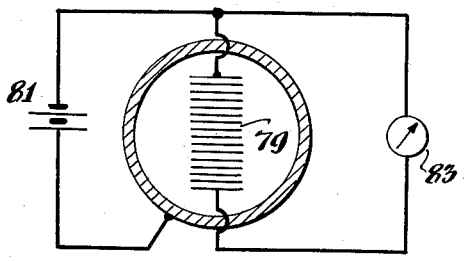
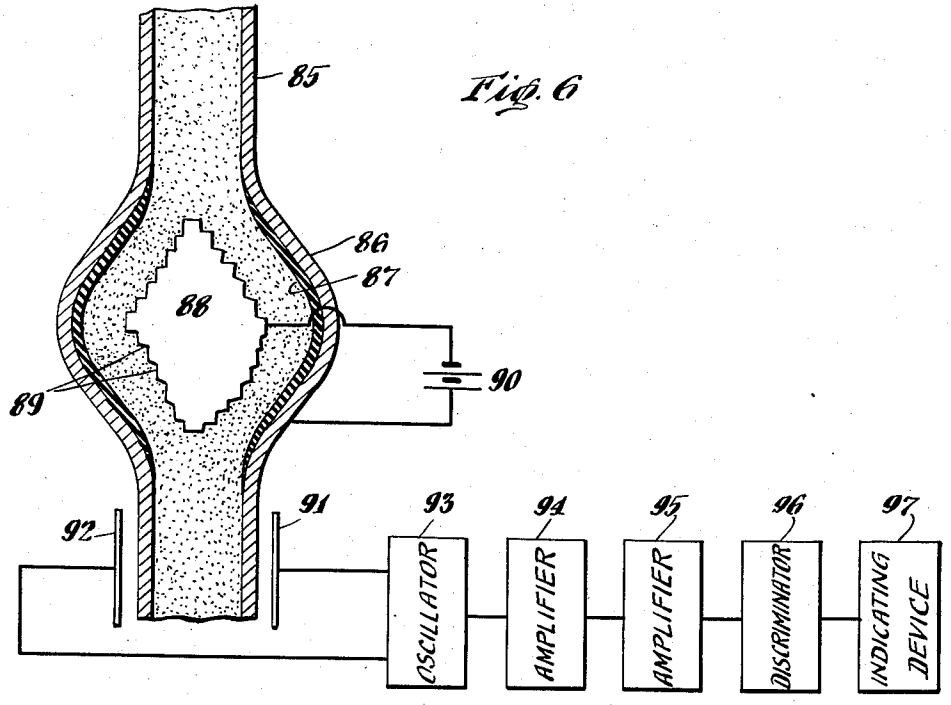


Fig. 6



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SAFETY SIGNAL DEVICE

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Application October 18, 1950, Serial No. 190,804

6 Claims. (Cl. 324—71)

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This invention relates to a safety signal device and particularly to a device for providing an immediate and accurate indication of the presence of metallic particles in a lubricant.

The presence of foreign substances, such as metallic particles and granular carbon in a continuous flow lubricating system is detrimental to the engine or machine in which the lubricant is being utilized. Granular carbon and particularly metallic particles are of an abrasive nature which results in a scoring of machine parts which are normally required to be held in extremely close tolerances. The scoring of machine parts and other damage resulting from the presence of abrasive metallic particles oftentimes results in a substantial rise in operating temperatures, which, together with other resulting detrimental effects, may lead to rapid engine failures.

In engines generally, and particularly in those incorporating a continuously circulating lubricant, the presence of metallic abrasive material is highly undesirable and is normally difficult to detect before considerable damage or engine failure results therefrom. This is particularly true in aircraft engines where a departure from standard operating conditions or engine failure may lead to great loss of life and damage to property.

This invention may be briefly described as a device for detecting and providing an immediate indication of the presence of metallic particles in a continuously flowing lubricant, of sufficient sensitivity to detect the presence of said particles before scoring and damage to close tolerance machine elements or engine failure results therefrom. The invention includes means for setting up an electric field of constant characteristics through which the lubricant is passed, with associated means responsive to a change in said constant electric field resulting from the presence of metallic particles therein, for providing an immediate indication of the presence of said particles.

In order to increase the response, to the indicating mechanism, of very small or relatively few particles in the oil stream I prefer to include means for appropriately charging the particles in advance.

An object of this invention is to provide a safety signal device for the detection of metallic particles in a flowing lubricant.

Another object of this invention is to provide a simple and efficient safety signal device for the detection of metallic particles in a flowing lubricant.

Another object of this invention is to provide

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a simple and inexpensive device for providing a clear external indication when the presence of metallic abrasive material in a lubricating system reaches a predetermined amount.

Another object of the invention is to render metallic particles in a flowing lubricant more readily detectable.

A further object of this invention is to combine in a flowing stream or closed circuit of lubricating liquid means for charging the extraneous particles such as metallic particles and quantitatively detecting the presence of such particles to give warning in ample time to prevent engine failure.

Other objects and advantages of the invention will be pointed out in the following disclosure and claims which disclose, by way of example, the principles of the invention and the preferred embodiments of the safety device applying those principles.

Referring to the drawings:

Fig. 1 schematically illustrates the presently preferred embodiment of the invention;

Fig. 2 schematically illustrates an alternative embodiment of the invention;

Fig. 3 schematically illustrates another alternative embodiment of the invention;

Fig. 4 schematically illustrates another alternative embodiment of the invention which includes means for both charging the particles and activating the detection mechanism;

Fig. 5 is a slight modification of the condenser structure shown in Fig. 4, and

Fig. 6 is another schematic diagram illustrating means for charging the particles in a flowing stream shown in conjunction with the detection method of Fig. 1 but which may also be used in conjunction with any of the alternatives shown in Figs. 2 to 5, inclusive.

Referring to Fig. 1, there is illustrated a portion of the lubricant containing line 10 formed of non-magnetic material through which the lubricant or a portion thereof continuously flows. Encircling the lubricant containing line 10 is a helical coil 12 connected to a suitable direct current source, such as the battery 14, in series with the primary winding 16 of the transformer 18.

The direct current source 14 connected in circuit with the coil 12 results in the formation of a magnetic field of constant and uniform characteristics within the lubricant flowing in the non-magnetic lubricant containing line 10. The presence of particles of magnetic material, such as small metallic particles, within the magnetic field generated by the coil 12 results in a change

in said magnetic field. The change in said magnetic field, which will be small, results in a change in the current flowing through the circuit including the coil 12, the direct current source 14 and the primary winding 16 of the transformer 18.

Connected in circuit to the secondary winding 22 of the transformer 18 is an oscillator 24 normally biased to provide a constant frequency output. The change in current flow in the primary winding 16 of the transformer 18 resulting from the presence of metallic particles in the lubricant in the line 10, results in a change in current flow in the secondary winding 22 which is used to vary the frequency of the oscillator 24. The output of the oscillator 24 is fed into two stages of conventional amplification 26 and 28 and the amplified output is fed into a discriminator 30. The discriminator circuit 30 provides a varying voltage output which is responsive to the change in frequency of the oscillator 24. The varying voltage output of the discriminator 30 is used to actuate an attention arresting indicating device 32, which may be a suitable light, buzzer, or other signaling device, through, for example, a suitable holding relay, to provide a warning signal of predetermined duration.

In the above embodiment of the invention the circuits for the oscillator 24, the amplifiers 26 and 28, and the discriminator 30 are of conventional and well-known construction, and, as no claim of novelty is being directed to these circuits individually, they are represented schematically in the drawings.

Fig. 2 illustrates an alternative embodiment of the invention. In this embodiment, there is illustrated a portion of the lubricant containing line 40 formed of non-magnetic material through which the lubricant or a portion thereof continuously flows. Encircling the lubricant containing line 40 is a helical coil 42 connected to a suitable direct current source, such as the battery 44, in series with the primary winding 46 of a transformer 48.

As described above with respect to Fig. 1, the direct current source 44 connected in circuit with the coil 42 results in a formation of a magnetic field of constant and uniform characteristics within the lubricant flowing in the non-magnetic lubricant containing line 40. The presence of a particle of magnetic material, such as small metallic particles, within the magnetic field generated by the coil 42 results in the change in said magnetic field. The change in the magnetic field results in a change in the current flowing through the circuit including the coil 42, the direct current source 44 and the primary winding 46 of the transformer 48.

Connected in circuit with the secondary winding 50 of the transformer 48 are several stages of amplification such as the amplifiers 52, 54 and 56. The change in current flow in the primary winding 46 of the transformer 48 resulting from the presence of metallic particles in the lubricant in the line 40 results in a change in current flow in the secondary winding 50. The change in current flow in the secondary winding 50 is utilized to vary the grid voltage in the amplifier 52. Said amplifier 52 is biased so that this change in grid voltage results in a corresponding amplified output. The amplified output of stage 52 is further amplified in stages 54 and 56. It should be noted at this point that a total of three stages of amplification are illustrated in the drawings. However, the number of stages of amplification required is determined by the amount of change in current flow resulting from the presence of metallic particles in the line 40 and the output required to trigger the indicating device 58. The amplified output in the embodiment illustrated in the drawings of stage 56 is used to trigger an eye-arresting indicating device 58 which may be a suitable light, buzzer, or other signaling device, through, for example, a suitable holding relay to provide a signal of predetermined duration.

In the embodiment of the invention illustrated in Fig. 2, the circuits for the amplifiers 52, 54 and 56 are of conventional and well-known construction, and as no claim of novelty is being directed toward these circuits individually, they are represented schematically in the drawing.

Fig. 3 illustrates another alternative embodiment of the invention. In this embodiment of the invention, there is illustrated a portion of a lubricant containing line 62 through which the lubricant or a portion thereof continuously flows. Bounding the line 62 are a pair of condenser plates 64 and 66 positioned so that the lubricant flowing in the line 62 serves as a dielectric therefor. The condenser plates 64 and 66 are included in the circuit of a oscillator 68 normally biased to provide a constant frequency output. The capacitance of the condenser formed by the plates 64 and 66 is a function of the dielectric material interposed therebetween, i. e. the lubricant flowing in the line 62. The presence of metallic particles in the lubricant flowing in the line 62 results in a change in the dielectric constant of the material interposed between the plates 64 and 66. The change in the dielectric constant varies the capacity of the condenser formed by such plates 64 and 66 and this variation in capacity is used to vary the frequency of the oscillator 68.

As described above in connection with Fig. 1, the output of the oscillator 68 is fed into two stages of conventional amplification 70 and 72 and the amplified output thereof is fed into a discriminator 74. The discriminator 74 provides a varying voltage output responsive to the change of frequency of the oscillator 66. The varying voltage output of the discriminator 74 may then be used to actuate a suitable indicating device 76 to provide an eye-arresting signal either directly or through an intermediate holding relay to provide a signal of predetermined duration.

In this embodiment of the invention, as in the embodiments illustrated in Figs. 1 and 2, the circuit arrangements of the units schematically represented are conventional and of well-known construction.

As illustrated in Fig. 4 a set of concentric condenser plates 77 of tubular form are mounted within and insulated from a tube or pipe 78 through which particles to be detected pass.

The condenser plates may be arranged as flat parallel sheets 79 as shown in Fig. 5 and the plates are charged by a suitable source of electricity marked 80 in Fig. 4 and 81 in Fig. 5.

The presence of the particles in passing between the plates 77 act to disturb the charge in the condenser and this disturbance or variation in capacity is recorded or signaled by suitable apparatus such as a voltmeter 82 as in Fig. 4 or as an ammeter 83 as in Fig. 5.

The inner wall of the tube or pipe may be insulated by any suitable coating or lining 84, means for amplifying the indication such as described in connection with the arrangement of Fig. 1 may be employed.

The particles as they pass through the spaces

between condenser plates will contact the plates and thus become charged which will magnify the effect as they continue to pass on.

Fig. 6 illustrates an alternative embodiment of the invention. In this arrangement there is illustrated a portion of a lubricant containing line or pipe 85 which is provided with an enlargement 86 having an insulating lining 87 and mounted within the enlargement is a charged body 88 having a corrugated or otherwise extended surface 89, the shape and size and mounting of the body being such as to provide adequate passage for the lubricant. The body 88 is charged by a suitable electrical source 90 so that the metallic or like particles in the stream will be charged as they contact the surface 89 of the body 88. As the charged particles continue through the line or pipe they influence the capacitance of a condenser having plates 91 and 92 which bound the line and are included in the circuit of an oscillator 93, normally biased to provide a constant frequency output. The capacitance of the condenser formed by the plates 91 and 92 is a function of the dielectric material interposed therebetween, i. e. the lubricant flowing in the line. The presence of extraneous charged particles in the lubricant flowing in the line 85 results in a change in the dielectric constant and thus varies the capacity of the condenser which in turn varies the frequency of the oscillator 93.

The output of the oscillator 93 is fed into two stages of conventional amplifications 94 and 95 and the amplified output thereof is fed into a discriminator 96 which is used to actuate an attention indicating device 97 which may be a suitable light, buzzer or other signaling device.

This part of the embodiment of my invention corresponds to the arrangement already shown and described in connection with Fig. 3 and the alternative arrangements of Figs. 1 and 2 may be substituted therefore if desired.

The advantage gained by the complete embodiment of my invention shown in Fig. 6 arises from the fact that the particles in the lubrication stream are charged as they come in contact with the extended surface of the charged body 88 and hence are more readily detected as they pass between the condenser plates 91 and 92.

This application is a continuation-in-part of my copending patent application Serial No. 159,302, filed May 1, 1950, for Safety Signal Device, which is now abandoned.

It is to be understood that the invention is not limited to the specific embodiments herein shown and described but may be carried out in other ways without departure from its spirit.

Having thus described my invention, I claim:

1. Apparatus for the detection of extraneous solid particles in a lubricant flowing in a line comprising means within the line for contacting and charging the particles as they flow therein, means associated with the line containing the flowing lubricant and spaced from said charging means for extending a constant electric field thereacross, means responsive to a change in said electric field resulting from the presence of the charged particles therein for effecting an electrical change and an indicating device responsive to said electrical change for providing an external indication of the change resulting from the presence of extraneous particles therein.

2. Apparatus for the detection of extraneous solid particles in a lubricant comprising means disposed within the flow of lubricant for electrically charging said extraneous particles, means associated with the flowing lubricant and spaced from said charging means for providing an electric field of constant characteristics through which the lubricant must pass, means responsive to changes in said electric field resulting from the presence of charged particles therein for effecting an electrical change of greater magnitude, and an indicating device responsive to said electrical change of greater magnitude for providing an external indication of the presence of said extraneous particles in said lubricant.

3. Apparatus for detection of extraneous solid particles flowing in a line comprising an electrically charged body disposed within said flowing lubricant for electrically charging said extraneous particles, a sensing device spaced from said charged body and positioned to provide a constant electric field through which the flowing lubricant and the charged particles therein must pass, means associated with said sensing device and responsive to changes in said electric field resulting from the presence of the charged particles therein for effecting electrical changes of greater magnitude, and an indicating device responsive to said electrical changes of greater magnitude for providing an external indication of the presence of said extraneous particles in said lubricant.

4. A method for detecting the presence of extraneous solid particles in a lubricant comprising the steps of charging said particles in said lubricant and measuring a change in a constant electric field through which said lubricant and said charged particles pass to detect the presence of said particles.

5. A method for detecting the presence of extraneous solid particles in a lubricant comprising the steps of charging said particles in said lubricant, passing said lubricant and said charged particles through an electric field of constant characteristics and measuring the change in said field resulting from the presence of said charged particles therein.

6. A method for detecting the presence of extraneous solid particles in a lubricant comprising the steps of charging a body disposed in the lubricant to place a charge on the extraneous particles therein, passing said lubricant and said charged particles through an electric field of constant characteristics and measuring the change in said field resulting from the presence of said charged particles therein.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,070,556	Strong	Aug. 19, 1913
1,808,709	Blake	June 2, 1931
1,973,414	Miller	Sept. 11, 1934
2,228,293	Wurzbach	Jan. 14, 1941
2,349,992	Schrader	May 30, 1944
2,387,496	Cornelius	Oct. 23, 1945
2,455,543	Williams	Dec. 7, 1948
2,491,445	Cunningham et al.	Dec. 13, 1949
2,512,879	Roggenstein	June 27, 1950