

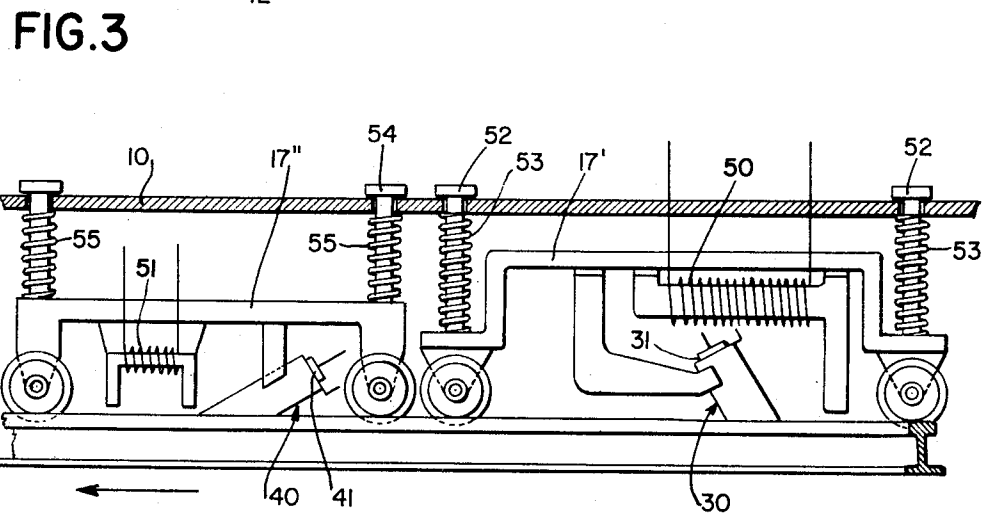
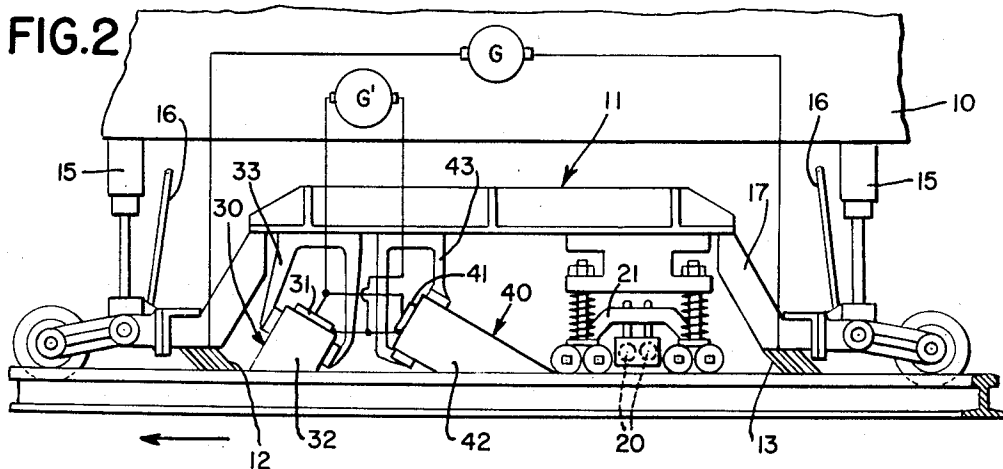
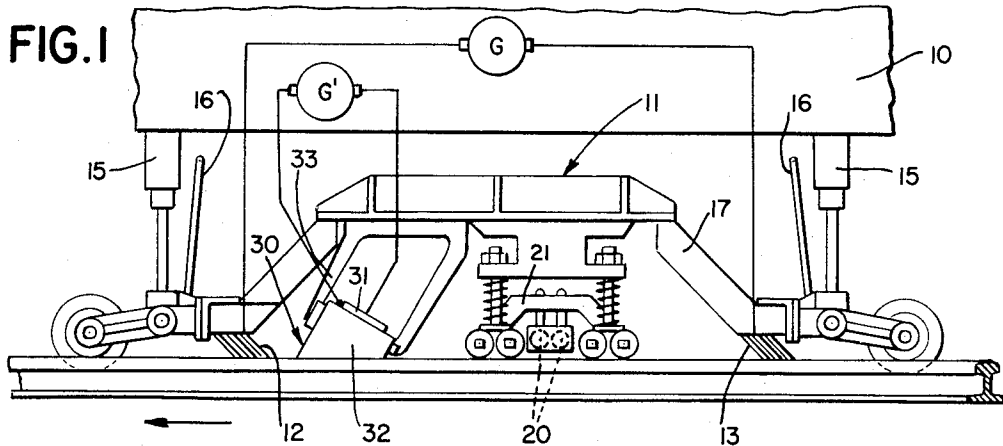
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METHOD AND MEANS FOR DETECTING FLAWS IN MAGNETIC MATERIAL

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METHOD AND MEANS FOR DETECTING FLAWS IN MAGNETIC MATERIAL

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This invention relates to rail flaw detector mechanism of the type employed in the Sperry rail flaw detector car. Such flaw detection apparatus comprises passing of a heavy current through the rail so as to establish an electromagnetic field surrounding the same and then moving a pair of opposed induction coils through this field at a constant distance above the rail head. When a flaw occurs the axis of the current is displaced and the said induction coils on encountering said displaced electromagnetic field will generate a differential E.M.F. which is then amplified, and the amplified voltage is caused to operate a recorder in the car and a paint gun for spraying the defective region of the rail.

The current is led into the rail by contact brushes and leaves the rail by a second set of brushes, both sets of brushes being carried by a carriage which supports the detector coils between the two sets of brushes. It has been found that it takes some time after the current enters the rail for the molecules to align themselves with the proper polarity relative to the polarity of the energizing current in order to obtain a maximum field strength with a given energizing current. For this purpose it has been proposed to employ a pre-energizing electric circuit in advance of the main energizing current to activate the molecules. Once the molecules are activated, the main energizing current is more effective to align the molecules. This method is disclosed in Patent No. 1,944,930, granted January 30, 1934.

It is therefore one of the principal objects of this invention to provide a method and means for pre-activating the molecules in advance of the main energizing circuit without the necessity of employing a pre-energizing electric circuit. More particularly, this invention relates to the use of ultrasonic vibrations to accomplish the result heretofore obtained by a pre-energizing electric circuit.

In the Sperry rail flaw detection method, the field of flux surrounding the rail is displaced not only by internal defects which it is desired to detect but also by surface defects such as engine wheel burns which are not the type of defects which should be detected. It is therefore another object of this invention to provide means for minimizing or eliminating the effect of such surface defects. More specifically, this invention provides for ultrasonic means for accomplishing this desirable result.

Further objects and advantages of this invention will become apparent in the following detailed description thereof.

In the accompanying drawings:

Fig. 1 is a side elevation of a portion of an electric type rail flaw detector car, largely diagrammatic, showing one embodiment of this invention for pre-activating the molecules.

Fig. 2 is a view similar to Fig. 1 showing another embodiment of this invention for pre-activating the molecules and for eliminating the effect of surface defects.

Fig. 3 is a view similar to Fig. 2 showing the invention applied to a magnetic type flaw detector.

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Referring to the drawings, there is shown a rail flaw detector car which comprises a car body 10 from which is suspended a detector mechanism 11 comprising a carriage 17 having spaced sets of brushes 12 and 13 for leading current into and out of the rail. The current may be supplied by a generator G mounted in the car body 10. The detector mechanism may be raised and lowered by means of air cylinders 15 and cables 16. The current brush carriage 17 supports a detector carriage 21 carrying a pair of opposed detector coils 20. As the car moves along the track, the coils normally cut a constant number of lines of force in the field surrounding the rail, but on entering a region of flaw where the field is distorted, the coils will generate a differential E.M.F. to operate various indicators.

As hereinbefore stated, it was found that in order to detect flaws efficiently the molecules must be aligned with proper polarity with respect to the entering current. This takes more time than is consumed by the sets of current brushes 12 and 13 passing over a given section of rail. In order to render this current more effective within this time interval, it has been found necessary to activate the molecules. One such system was disclosed in my Patent 1,944,930, which, however, required an additional electric energizing circuit in advance of the main energizing circuit. By this invention, I accomplish the same result by the use of an ultrasonic transducer 30 which may comprise a piezo-electric element, such as a quartz crystal 31 mounted upon a support 32, the transducer being supported in a bracket 33 suspended from carriage 17. The support 32 may be rectilinear to transmit the vibrations normal to the rail, or preferably, as shown, it may be a wedge to transmit the vibrations forwardly at a relatively acute angle of incidence. The transducer 30 may be mounted just back of the leading current brushes 12. The crystal may be energized continuously at ultrasonic frequency from generator G', and the angle of incidence is such as to project the vibrations deeply into the rail head. The molecules of the entire rail section, and especially the rail head, are thus activated ultrasonically, and such activation will render the energizing current between brushes 12 and 13 more effective to align the molecules.

As stated in the introduction hereto, surface imperfections of the rail, such as engine burns, which it is not desired to detect because they do not affect the soundness of the rail, nevertheless distort the electromagnetic field in the same manner as dangerous internal defects. In order to avoid indicating such surface defects, I make use of the principle that if a magnetic conductor is vibrated in the immediate vicinity of a defect, such defect is not detected by coils 20. Therefore, if only the region of the rail adjacent the rail head surface in the vicinity of the detecting mechanism could be vibrated without vibrating deeply into the interior, the defects on the surface would not be detected. For this purpose I utilize a continuously energized ultrasonic transducer 40 which may be similar to transducer 30 except that the angle of incidence of vibrations generated thereby is much greater so that the vibrations will affect only the outer surface. The transducer 40 is positioned closely adjacent the detector coils 20, and the direction of vibrations is toward these coils. Under these operating conditions the coils 30 will not detect surface defects, but will continue to respond to internal defects.

In Fig. 3 I have disclosed how the principles of the Fig. 2 form of the invention may be applied to the magnetic type of testing. In this type a one-legged energizing magnet 50 magnetizes a section of rail, and variations in flux caused by defects (surface and internal) are detected by a pick-up coil 51. The magnets may be supported on carriages 17', 17'', which are suspended from

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the car body by bolts 52, 54, and springs 53, 55. The activating transducer 30 is again mounted in the field of energization of energizing magnet 50 and facing in the direction of travel. The angle of incidence of ultrasonic vibrations generated thereby is relatively small to provide deep penetration. The transducer 40 is mounted adjacent the pick-up coil 51 and the angle of incidence of entering ultrasonic vibrations is relatively large to cause these vibrations to affect only the region of rail adjacent the surface.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. In a rail flaw detection system in which the rail is progressively energized with flux in a given length of rail and flux responsive means is employed for detecting variations in flux, the method of activating the rail portion which is to be energized and of rendering the flux responsive means insensitive to flux variations caused by surface defects, which comprises transmitting continuous ultrasonic vibrations to a substantial depth into the rail in the field of the energization to provide activation and transmitting continuous ultrasonic vibrations to a shallow depth into the rail adjacent the flux responsive means.

2. In a rail flaw detection system, the method of progressively energizing the rail with flux in a given length of rail, detecting variations in flux with flux responsive means, and activating the rail portion which is to be energized by transmitting continuous ultrasonic vibrations into the rail in the field of energization in advance of the flux responsive means.

3. The method as specified in claim 2, in which the ultrasonic vibrations are transmitted into the rail at an angle of incidence sufficiently acute to cause the vibrations to penetrate the rail to a substantial depth.

4. The method as specified in claim 5, in which the ultrasonic vibrations are transmitted into the rail in the direction of travel.

5. In a rail flaw detection system, the method of progressively energizing the rail with flux by sets of brushes spaced apart along the rail a given length, detecting variations in flux by flux responsive means posi-

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tioned near the rear set of brushes, and activating the rail portion which is to be energized by transmitting continuous ultrasonic vibrations into the rail adjacent to the front set of brushes.

6. In a rail flaw detection system, the method of progressively energizing the rail with flux in a given length of rail, detecting variations in flux with flux responsive means, and rendering the flux responsive means insensitive to flux variations caused by surface defects by transmitting continuous ultrasonic vibrations to a shallow depth into the rail adjacent the flux responsive means.

7. The method as specified in claim 6, in which the vibrations are transmitted into the rail in a direction opposite to the direction of travel.

8. In a rail flaw detector car, means for energizing with flux a portion of rail as the car moves along the rail, flux responsive means for detecting variations in flux, a transducer mounted in the region of the energized portion of rail, means for continuously energizing said transducer at ultrasonic frequency, a support for said transducer engaging the rail, said support being a wedge positioned so that the ultrasonic vibrations of the transducer will enter the rail at a sufficiently acute angle of incidence to penetrate the rail to a substantial depth, said wedge being positioned to transmit the vibrations in the direction of travel, a second transducer closely adjacent the flux responsive means, a second wedge for supporting said second transducer and engaging the rail, the second wedge being positioned so that the ultrasonic vibration will enter the rail at an angle of incidence sufficiently large to cause the vibrations to enter the rail to a shallow depth and in a direction opposite to the direction of travel.

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