

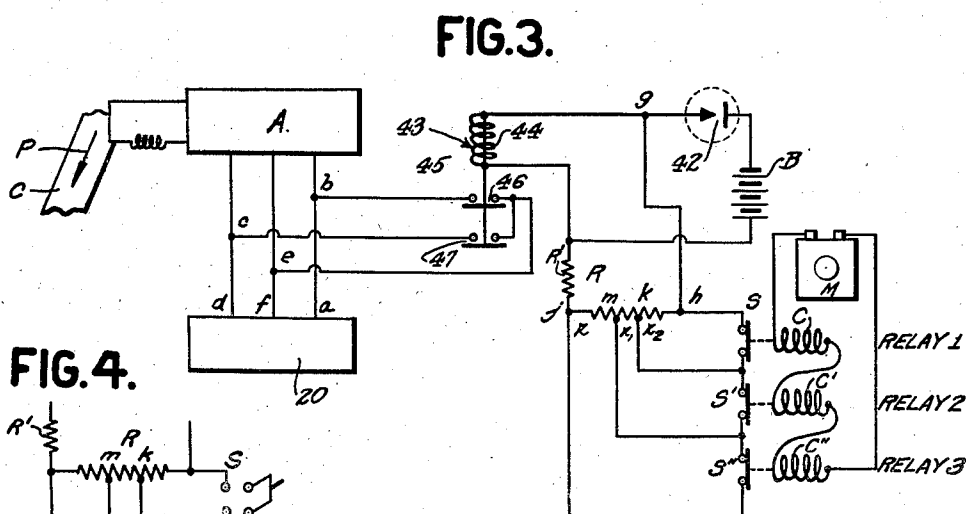
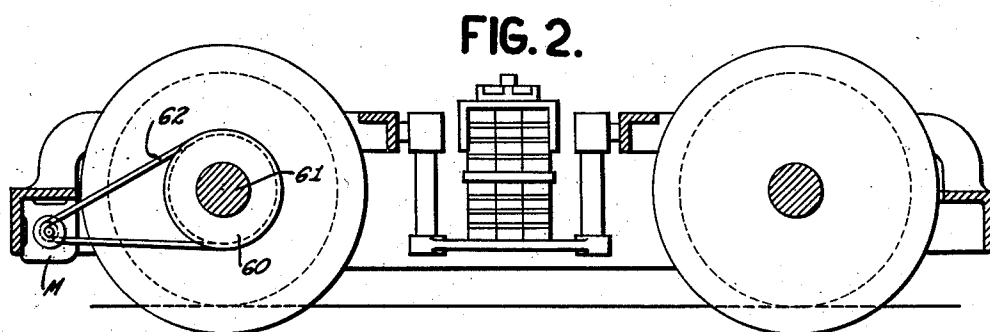
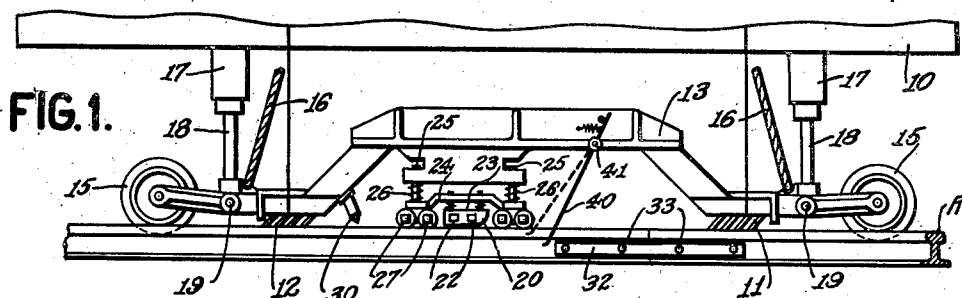
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RAIL FLAW DETECTOR MECHANISM

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RAIL FLAW DETECTOR MECHANISM

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This invention relates to rail flaw detector mechanisms and is particularly designed for application upon the type of detector mechanism employed on the Sperry rail flaw detector car. This car operates upon the principle of passing current through the rail to establish an electromagnetic field surrounding the same and exploring said field by inductive means to discover any irregularities caused by the presence of fissures or other discontinuities in the rail. The particular problem which presents itself here arises from the fact that rails are joined by angle-bars, bolts, etc., which joints constitute in themselves irregularities in the rail which will cause variations in the electromagnetic field in the same manner as an internal fissure. Therefore, for the interval during which the inductive detector means is passing over the rail joint the Sperry car employs a mechanism for short-circuiting the connection between the detector mechanism and the indicating mechanism so that the irregularities caused by the rail joint will have no effect upon the indicating mechanism.

The specific joint cutout mechanism to which this invention relates consisted of a pivoted finger carried by the detector carriage in advance of the detector mechanism and adapted to engage the angle-bar at the joint before the detector mechanism reached the angle-bar. Throughout the time that the joint finger rode along the angle-bar the joint cutout mechanism was effective and when the joint finger left the angle-bar the detector mechanism would ordinarily again become effective. This was not desirable because, since the joint cutout finger was positioned in advance of the detector mechanism, the detector mechanism would still be over the angle-bar when the joint finger had left the bar. Therefore it was proposed to provide a delayed action arrangement in the short-circuiting mechanism controlled by the joint finger, so that the short-circuit would remain effective for a predetermined interval after the joint finger had left the angle-bar and sufficient to permit the detector mechanism also to pass beyond the angle-bar.

The above described arrangement would be satisfactory if the detector car always proceeded at substantially the same rate, or within a very narrow range. In recent years, however, detector cars have been operated at higher speeds normally, but when passing through frogs, switches, etc. it was necessary to slow down the car appreciably. Thus, whereas a car might test at a normal testing speed of 9 or 10 miles an hour,

this speed would be cut down to 5 or 6 miles an hour when testing through frogs and switches. It will now be seen that if a time delay were introduced in the short-circuit between the detector mechanism and the indicator mechanism sufficient just to permit the detector mechanism to pass beyond the angle-bar when the car was travelling 10 miles an hour, this delay would be insufficient when the car was travelling 5 miles an hour, in which case an appreciably longer time delay would be necessary to permit the detector mechanism to pass beyond the angle-bar. If the additional delay were not provided when the car operated at a slower speed, then the short-circuit between the detector mechanism and the indicating mechanism would be rendered ineffective while the detector mechanism was still above the angle-bar, and as a result the electromagnetic field distortion caused by the angle-bar would operate the indicating mechanism in the same manner as a flaw. This condition, therefore, resulted in false indications which required an operator to stop the car for investigation of the rail or else for readjustment of the cutout system.

It is the principal object of this invention to provide means whereby the time interval which elapses between the time that the joint finger leaves the angle-bar and the time that the detector mechanism is again effective to operate the indicating mechanism may be varied either at the will of the operator by manual setting when the operator slows down the detector car, and in proportion to said slowing down, or whereby said time delay interval may be automatically varied in response to the varying speeds of the detector car.

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

In the accompanying drawing,

Fig. 1 is a side elevation of a portion of the rail fissure detector car having my invention applied thereto.

Fig. 2 is a side elevation of a portion of the truck of a rail fissure detector car showing the driving mechanism employed in this invention.

Fig. 3 is a wiring diagram.

Fig. 4 is a portion of a wiring diagram showing a modified hand operated form.

Referring to Fig. 1 of the drawing, there are shown the parts of a standard Sperry rail fissure detector car which includes a car body 10 operating along the rails R. Fissure detection is accomplished by passing current through each

rail from a generator within the car body supplying current to spaced current brushes 11 and 12 supported upon the current brush carriage 13 which when in lowered or effective position is adapted to ride upon the rail by means such as wheels 15. The current brush carriage 13 is normally held in elevated or ineffective position by means of springs, not shown, and cables 16, but when it is desired to lower said carriage, fluid pressure such as compressed air is supplied to the cylinders 17 to force out pistons 18 which are pivotally connected at 19 to the current brush carriage 13. The current passed through the rail by way of spaced brushes 11 and 12 will establish an electromagnetic field surrounding the rail and this field will be uniform except in the region of flaw, where it will be distorted. Such distortions of the electromagnetic field are detected by a flaw responsive mechanism 20 which may take the form of a pair of opposed induction coils 22 supported in a housing 23 at a constant distance above the rail surface by means of a carriage 24. Said carriage 24 is mounted on current brush carriage 13 by means of loosely fitting bolts 25 and springs 26 to permit said carriage 24 while riding on the rail on means such as wheels 27, to move independently of carriage 13 so that the said carriage 24 may at all times maintain parallelism with the rail surface regardless of irregularities thereof. The coils 22 normally cut the same number of lines of force, but on entering a region of flaw, first one coil and then the other will cut a different number of lines of force to generate a differential E. M. F. which after being suitably amplified by an amplifier A may be caused to actuate a pen P operating on a chart C. At the same time that the pen is actuated, there is actuated also marking means which may take the form of a paint gun 30 mounted on the current brush carriage 13 a sufficient distance behind the flaw responsive members 22 to compensate for the movement of the car and for the lag in operation of the paint gun.

As stated in the introduction hereto, the rails are held together by joints which may comprise an angle-bar 32, bolts 33, and additional members, all of which constitute the rail joint, and this rail joint serves to deflect the current passing through the rails and vary the electromagnetic field surrounding the same. Unless means were provided for preventing such action, it is understood that the searching unit would respond to the variation in electromagnetic field caused by the rail joint just the same as it responds to variations in the said field caused by fissures and other defects. Since it is not desired that the indicating mechanism and the paint gun be operated at every joint, means are provided for cutting out the action of the indicating means for the interval during which the searching unit is passing through the region of the electromagnetic field which is affected by the rail joint. The mechanism heretofore employed and to which this invention relates consists of a joint finger 40 pivoted at 41 on the current brush carriage and so positioned as to slide along the edge of the rail so that it will engage the angle-bar which will tilt the finger about its pivot. Such tilting is caused to close a set of contacts 42 (see Fig. 3) to close a circuit comprising a battery B and a relay 43 comprising a coil 44 and armature 45, which coil attracts its armature to close a short-circuit between the search unit 20 and the amplifier A. When the coil 44 attracts its armature, sets of contacts 46, 47 are closed, and there

is established a circuit extending from the search unit by way of points a, b, 46, 47, c, d, and a, b, 46, e, f, to short-circuit the connections between the search unit and the various input channels to the amplifier. The finger 40 is so positioned in advance of the search unit 20 as to close contacts 42 when the leading edge of the search unit approaches the field of distortion set up by the angle-bar.

As long as the finger 40 rides upon the angle-bar the short circuits described above will be effective to prevent the search unit from sending sufficient impulses into the amplifier to operate the indicating mechanism. When the finger 40 leaves the angle-bar, this would ordinarily open contacts 42 and again permit the search unit 20 to send impulses into the amplifier A. When finger 40 has left the angle-bar, it will be seen that the search unit is still over said bar and in the field of distortion caused by the bar. This would result in an impulse being transmitted by the search unit to the amplifier and would cause operation of the indicating means to give a false indication. The indication is false because it does not indicate the region of a defect but is due entirely to the rail joint. It is desirable, therefore, that a time delay be introduced in the short circuits between the searching unit and the amplifier so that said circuits will not open for a predetermined interval after contacts 42 have opened. For this purpose the coil 44 has a parallel circuit extending from the coil to points g, h, resistance R, R' and return to the relay coil. It will now be seen that here is a closed parallel circuit through which the current of battery B is normally flowing while contacts 42 are closed, but when contacts 42 are opened there is generated in the said closed parallel circuit, by reason of its self-inductance, a voltage which will cause current to flow in the said closed circuit until the current thus induced is dissipated. The rate of dissipation of said induced current will depend upon the amount of resistance in the closed circuit. The greater the resistance the quicker the induced current will be dissipated.

Heretofore, an amount of resistance was placed in the said parallel circuit calculated for a given speed of car, so that at the said car speed, when the finger 40 had left the angle-bar, a sufficient interval would elapse so that the searching unit 20 would just pass the leaving end of the angle-bar. This condition was satisfactory while detector cars operated at relatively low speeds of between 5½ and 6½ miles per hour. However, when the cars began to operate at higher speeds up to the present rate of 10 miles per hour, this condition of pre-setting of the resistance in the time delay circuit was unsatisfactory because there were times when the car had to be operated at slower speeds as low as 5 miles per hour for given conditions of track. The variation between 10 miles per hour and 5 miles per hour is so steep that a time delay circuit set for the higher speed will result in the circuits between the search unit and the amplifier becoming effective while the search unit is still over the angle-bar if the car is travelling at the lower speed of 5 or 6 miles per hour. To obviate this condition and to permit the car to operate with freedom from false indications due to joints regardless of the speed of the car, I have provided means whereby either automatically in response to the speed of the car, or at the will of the operator without leaving the car, the said time delay circuit may

be varied in a manner to accomplish the desired result.

In Fig. 3 I have disclosed a form of invention wherein the time delay following the opening of contacts 42 is automatically varied inversely as the speed of the car, so that the faster the car travels the shorter is the time delay interval, and the slower the car travels the longer is the time delay interval which occurs between the opening of contacts 42 and the opening of the short circuits between the search unit and the amplifier. For this purpose I provide in the closed parallel circuit 44, *g, h, R, R', 44*, a construction whereby more or less resistance may be introduced in or cut out of the said circuit, depending upon the speed of the car. For this purpose the resistance *R* comprises a plurality of resistance elements *r, r₁, r₂*. When the car is travelling at low speed, for instance 5 to 6 miles per hour, the said resistance elements *r, r₁, r₂* are short circuited by a shunt leading from *h* to switch *S*, switch *S'*, switch *S''*, to *j*. Thus none of resistance *R* is in the circuit and the closed parallel circuit offers a minimum of resistance to the current induced when contacts 42 are opened. Therefore it will take the maximum time within which to dissipate the said induced current. This is the condition which is desired because at the slow rate of speed of the car a longer interval elapses between the time that joint finger 40 passes off the angle-bar and the time that the search unit passes off the angle-bar. As the speed of the car increases, switch *S* is designed to open and the closed circuit now extends through point *h*, resistance *r₂*, point *k*, switch *S'*, switch *S''* to point *j*. Thus resistance *r₂* has been introduced in the closed circuit and the induced current will be dissipated somewhat more rapidly than when switch *S* was also closed. Similarly, as the car speeds up, switches *S* and *S'* are designed to open so that the closed circuit will lie through *h, r₂, r₁, n, switch S'', point j*. Thus resistances *r₁* and *r₂* are now in the closed circuit and the induced current will be dissipated still more quickly. Finally, when the car reaches 9 miles per hour, all three switches *S, S', S''* are designed to open, and the closed circuit now lies through *h, resistance r₂, resistance r₁, resistance r, to point j*. Thus all of resistance *R* is now in the circuit and the induced current will be dissipated rapidly.

For controlling the switches *S, S', and S''* in response to the speeds of the car, there are provided coils *C, C', C''* connected in series with each other and with a magneto *M*. This magneto may be mounted on the truck *T* shown in Fig. 2 and designed to be driven from an axle pulley 60 on the truck axle 61 by means of cable 62. The magneto will thus generate a current which is a function of the speed of the car. The coils *C, C', C''* are of such properties that at slow speed of the car, magneto *M* is generating only enough current to permit coil *C* to attract its armature and open switch *S*. As the speed increases, magneto *M* generates enough current so that coils *C* and *C'* can attract their armatures and thus open switches *S* and *S'*; while, at the speed of 9 miles per hour or more, the magneto is delivering enough current to energize all three coils so that all three switches can be opened.

In a modified form of the invention as disclosed in Fig. 4 the operator may control the resistances *r, r₁, r₂* by operating the switches *S, S', S''* by hand. Thus, when the car is operating at its normal, relatively high testing speed, the oper-

ator will open all three switches so that the maximum resistance is present in the closed circuit. When he finds it necessary to slow down the car he will close one or more of the switches, depending upon the amount of reduction in speed of the car, so as to short out one or more of the resistance elements *r₂, r₁, r* to increase the time delay of the closed circuit corresponding to the amount of decrease in the speed of the car.

In accordance with the provisions of the patent statutes, I have herein described the principle and operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other equivalent means. Also, while it is designed to use the various features and elements in the combination and relations described, some of these may be altered and others omitted without interfering with the more general results outlined, and the invention extends to such use.

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

1. In a rail flaw detector car adapted to travel over rails connected by joints, means for establishing an electromagnetic field surrounding the rail, means responsive to variations in said field caused by defects in the rail, said means responding also to variations in said field caused by said joints, cutout means carried by said detector mechanism in advance of said responsive means and adapted to cooperate with said joints, means for short-circuiting the output of said responsive means, means whereby said short-circuiting means is rendered effective when said cutout means is in cooperative relation to said joints, means for maintaining said short-circuiting means effective for a predetermined length of time after said cutout means has passed out of cooperative relation to said joint, and means responsive to the speed of the car along the rails for varying the predetermined length of time in inverse ratio to the speed.

2. In a rail flaw detector car adapted to travel over rails connected by joints, means for establishing an electromagnetic field surrounding the rail, means responsive to variations in said field caused by defects in the rail, said means responding also to variations in said field caused by said joints, cutout means carried by said detector mechanism in advance of said responsive means and adapted to cooperate with said joints, means for short-circuiting the output of said responsive means, means whereby said short-circuiting means is rendered effective when said cutout means is in cooperative relation to said joints, means for maintaining said short-circuiting means effective for a predetermined length of time after said cutout means has passed out of cooperative relation to said joint, means for varying said predetermined length of time, and means whereby said last-named means is controlled in accordance with the speed of said car along the rails.

3. In a rail flaw detector car adapted to travel over rails connected by joints, means for establishing an electromagnetic field surrounding the rail, means responsive to variations in said field caused by defects in the rail, said means responding also to variations in said field caused by said joints, indicating means, means whereby said responsive means actuates said indicating means, cutout means carried by said detector mechanism in advance of said responsive means and adapted

to cooperate with said joints, means whereby said cutout means renders said responsive means ineffective to actuate said indicating means when said cutout means is in cooperative relation to said joints, means for maintaining said responsive means ineffective to actuate said indicating means for a predetermined length of time after said cutout means has passed out of cooperative relation to said joint, and means responsive to the speed of the car along the rails for varying the predetermined length of time in inverse ratio to the speed.

4. In a rail flaw detector car adapted to travel over rails connected by joints, means for establishing an electromagnetic field surrounding the rail, means responsive to variations in said field caused by defects in the rail, said means responding also to variations in said field caused by said joints, indicating means, means whereby said responsive means actuates said indicating means, cutout means carried by said detector mechanism in advance of said responsive means and adapted to cooperate with said joints, means whereby said cutout means renders said responsive means ineffective to actuate said indicating means when said cutout means is in cooperative relation to said joints, means for maintaining said responsive means ineffective to actuate said indicating means for a predetermined length of time after said cutout means has passed out of cooperative relation to said joint, means for varying said predetermined length of time, and means whereby said last-named means is controlled in accordance with the speed of said car along the rails.

5. In a rail flaw detector car adapted to travel over rails connected by joints, means for establishing an electromagnetic field surrounding the rail, means responsive to variations in said field caused by defects in the rail, said means responding also to variations in said field caused by said joints, cutout means carried by said detector mechanism in advance of said responsive means and adapted to cooperate with said joints, means for short-circuiting the output of said responsive means, means whereby said short-circuit means is rendered effective when said cutout means is in cooperative relation to said joints, means for maintaining said short-circuiting means effective for a predetermined length of time after said cutout means has passed out of cooperative relation to said joint, said last named means comprising a closed circuit having inductance and resistance therein, means whereby a current is induced therein when said cutout means passes out of cooperative relation to said joint, and means for varying said predetermined length of time, said last-named means comprising means responsive to the speed of the car along the rails for varying the resistance in said closed circuit in direct ratio to the speed.

6. In a rail flaw detector car adapted to travel over rails connected by joints, means for establishing an electromagnetic field surrounding the rail, means responsive to variations in said field caused by defects in the rail, said means responding also to variations in said field caused by said joints, cutout means carried by said detector mechanism in advance of said responsive means and adapted to cooperate with said joints, means for short-circuiting the output of said responsive means, means whereby said short-circuiting means is rendered effective when said cutout means is in cooperative relation to said joints, means for maintaining said short-circuiting means effective for a predetermined length of

time after said cutout means has passed out of cooperative relation to said joint, said last named means comprising a closed circuit having inductance and resistance therein, means whereby a current is induced therein when said cutout means passes out of cooperative relation to said joint, and means for varying said predetermined length of time, said last-named means comprising means controlled by the speed of the car, and means whereby said speed-controlled means varies the resistance in said closed circuit.

7. In a rail flaw detector car adapted to travel over rails connected by joints, means for establishing an electromagnetic field surrounding the rail, means responsive to variations in said field caused by defects in the rail, said means responding also to variations in said field caused by said joints, cutout means carried by said detector mechanism in advance of said responsive means and adapted to cooperate with said joints, means for short-circuiting the output of said responsive means, means whereby said short-circuiting means is rendered effective when said cutout means is in cooperative relation to said joints, means for maintaining said short-circuiting means effective for a predetermined length of time after said cutout means has passed out of cooperative relation to said joint, said last named means comprising a closed circuit having inductance and resistance therein, means whereby a current is induced therein when said cutout means passes out of cooperative relation to said joint, and means for varying said predetermined length of time, said last-named means comprising means controlled by the speed of the car, and means whereby said speed-controlled means varies the resistance in said closed circuit in direct ratio to the speed of said car along the rails.

8. In a rail flaw detector car adapted to travel over rails connected by joints, means for establishing an electromagnetic field surrounding the rail, means responsive to variations in said field caused by defects in the rail, said means responding also to variations in said field caused by said joints, cutout means carried by said detector mechanism in advance of said responsive means and adapted to cooperate with said joints, means for short-circuiting the output of said responsive means, means whereby said short-circuiting means is rendered effective when said cutout means is in cooperative relation to said joints, means for maintaining said short-circuiting means effective for a predetermined length of time after said cutout means has passed out of cooperative relation to said joint, said last named means comprising a closed circuit having inductance and resistance therein, means whereby a current is induced therein when said cutout means passes out of cooperative relation to said joint, and means for varying said predetermined length of time, said last-named means comprising a magneto adapted to be driven in accordance with the movements of the car, a plurality of relays of different strengths connected in series with said magneto, and means whereby said relays control portions of said resistance in said closed circuit whereby the amount of resistance in said circuit varies in direct ratio to the speed of said car along the rails.

9. In a rail flaw detector car adapted to travel over rails connected by joints, means for establishing an electromagnetic field surrounding the rail, means responsive to variations in said field caused by defects in the rail, said means responding also to variations in said field caused by said

joints, cutout means carried by said detector mechanism in advance of said responsive means and adapted to cooperate with said joints, cutout operating means for rendering the output of said responsive means ineffective, means whereby said operating means is rendered effective when said cutout means is in cooperative relation to said joints, means for maintaining said operat-

ing means effective for a predetermined length of time after said cutout means has passed out of cooperative relation to said joint, means for varying said predetermined length of time and means whereby said last-named means is controlled by the speed of said car along the rails.

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