

Nov. 1, 1960

G. DE G. COWAN ET AL
RAIL FLAW DETECTOR MECHANISM

2,958,818

Filed May 1, 1957

2 Sheets-Sheet 1

FIG. 1

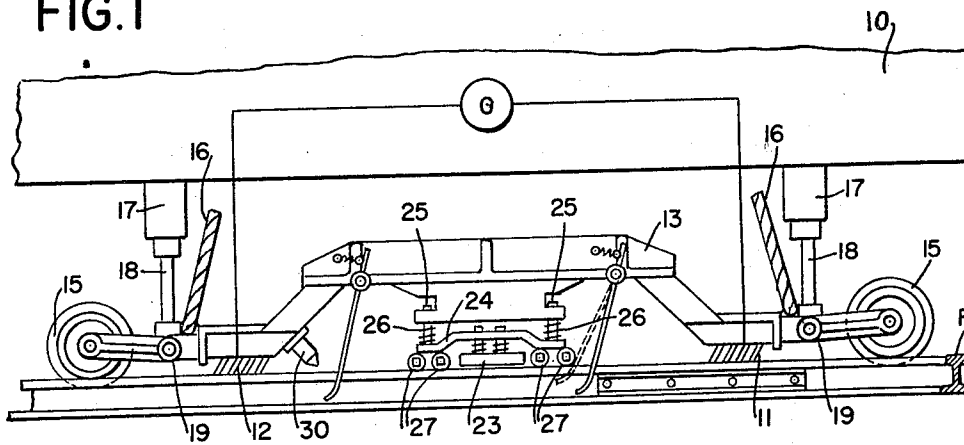


FIG. 2

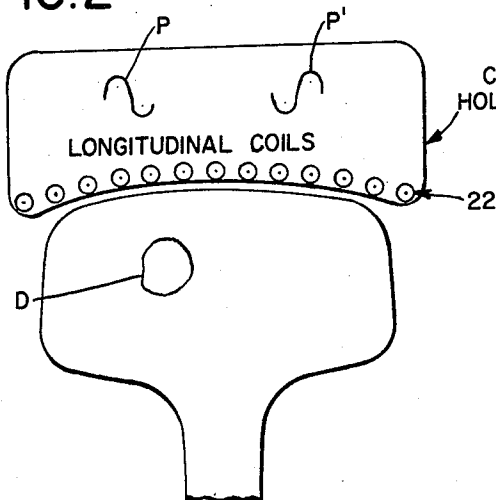


FIG. 3

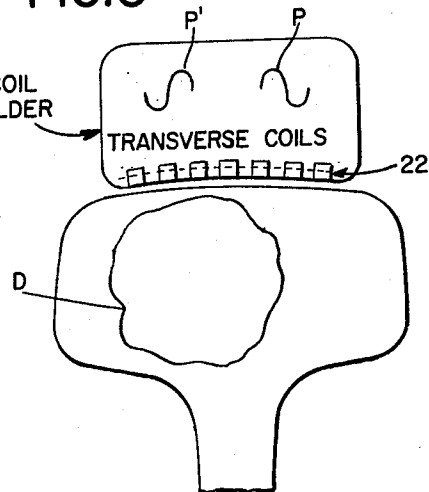
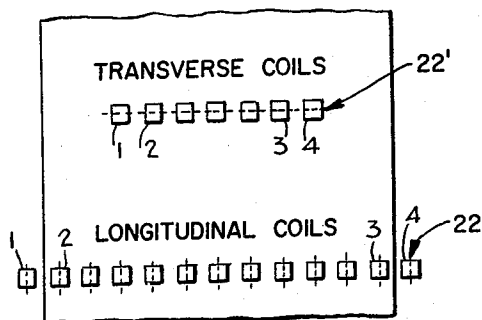


FIG. 4



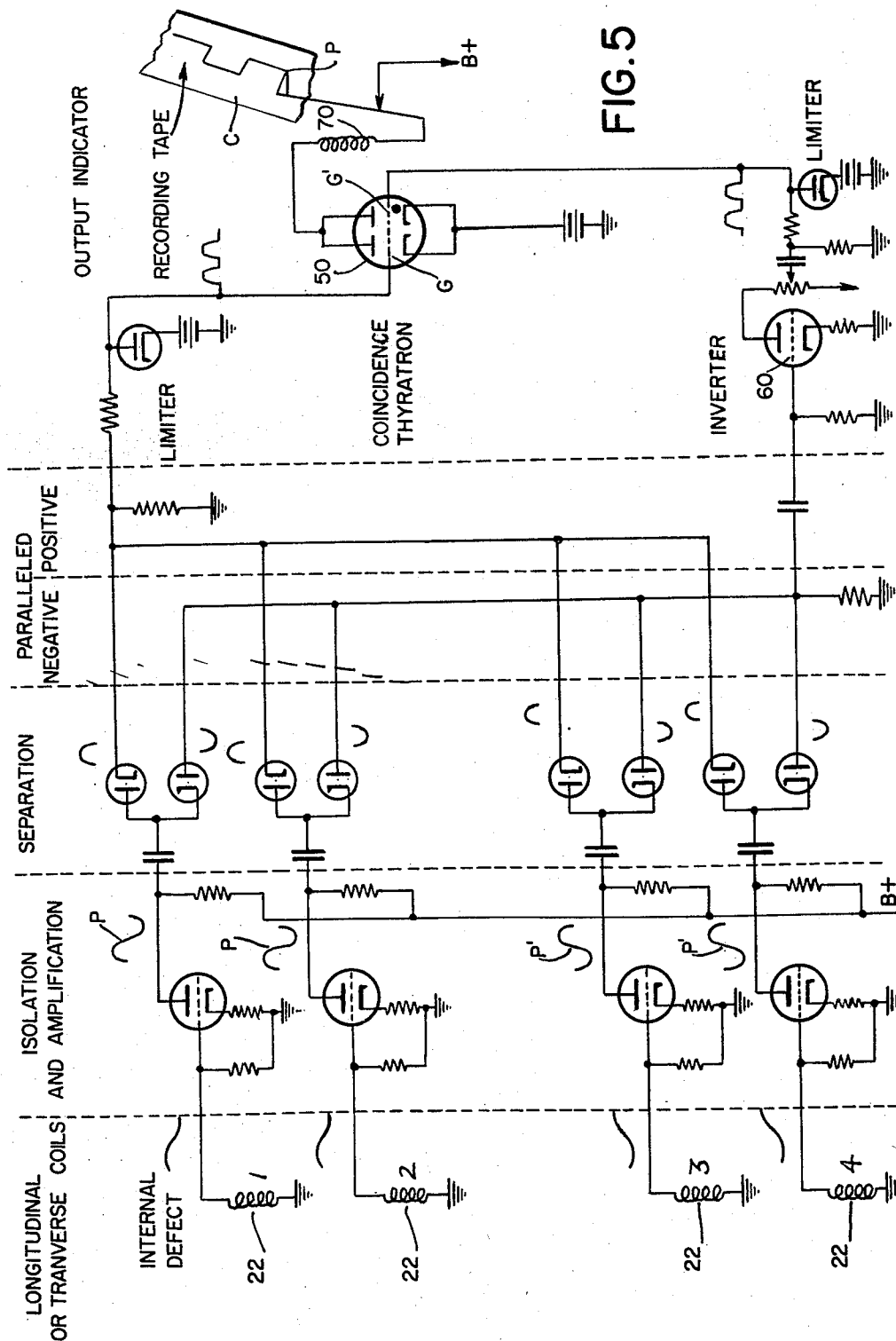
Nov. 1, 1960

G. DE G. COWAN ET AL
RAIL FLAW DETECTOR MECHANISM

2,958,818

Filed May 1, 1957

2 Sheets-Sheet 2



1

2,958,818

RAIL FLAW DETECTOR MECHANISM

Gerald de G. Cowan, New Preston, Robert Laurenson, New Milford, and Peter R. Van Hemert, Sherman, Conn., assignors to Sperry Products, Inc., Danbury, Conn., a corporation of New York

Filed May 1, 1957, Ser. No. 656,450

5 Claims. (Cl. 324—37)

This invention relates to rail fissure detector mechanisms, and more particularly to the type of detector mechanism employed on the Sperry rail flaw detector car. This car operates upon the principle of energizing the rail with flux, as, for instance, by passing direct 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 internal fissures or other discontinuities in the rail. Such irregularities will cause the inductive means to generate an E.M.F. which, after being suitably amplified, may be caused to operate an indicator, such as a recorder, within the car and a paint gun for marking the rail with paint in the region of flaw.

The particular problem which presents itself here arises from the fact that variations in the electromagnetic field surrounding the rail are set up not only by internal fissures which it is the function of the mechanism to detect, but also by surface irregularities, such as burns, shelly rail, flowed rail and slivers, which are not detrimental to the use of the rail and which it is not the object of the car to detect.

The operator within the car, seeing the indication upon the recording tape must, therefore, use his own judgment derived from viewing the rail from the car to determine whether the mark has been caused by a surface defect or by an internal fissure. Frequently this results in many unnecessary stops of the car for the purpose of hand testing the region where indications are made.

It is therefore the principal object of this invention to provide a method and means which may be employed on detector cars of the Sperry type which will substantially eliminate the recording of surface defects of the type hereinbefore mentioned so that only true internal defects will be apparent to the operator.

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 a rail fissure detector car having this invention applied thereto.

Fig. 2 is a vertical section through a rail head showing in diagrammatic form an arrangement of detector coils having longitudinal axes positioned relative to the rail head.

Fig. 3 is a view similar to Fig. 2 showing an arrangement of coils having their axes transverse with respect to the rail head.

Fig. 4 is a plan view showing the rail head with the two sets of coils positioned relative thereto.

Fig. 5 is an electric wiring diagram embodying the principle of this invention.

Referring to Fig. 1 of the drawings, 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 energizing the rail with flux by passing high amperage, low voltage current through each rail from a generator O within the

2

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 rails 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 cable 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 which may take the form of a plurality of induction coils 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 said carriage 24 may at all times maintain parallelism with the rail surface regardless of irregularities thereof. The induction coils within housing 23 normally cut the same number of lines of force, but on entering a region of flaw, they will cut a different number of lines of force to generate an E.M.F. which may be caused to operate a pen P operating on a chart C (see Fig. 5) and to actuate a marking means such as paint gun 30 mounted on the current brush carriage 13 for spraying the rail in the region of flaw with paint.

As stated in the introduction hereto, the inductive means will respond to variations in the electromagnetic field caused not only by the presence of internal fissures which deflect the path of the current and therefore vary the electromagnetic field surrounding the rail, but said coils will also respond to variations in the field caused by surface irregularities of the type enumerated in the introduction hereto, i.e. surface burns, shelly and flowed rail, and slivers.

We have therefore devised the following method and means for distinguishing between surface defects and true defects whereby only the latter will become apparent to the operator. Dependent upon the position of a coil relative to the location of a fissure flaw in the rail, the signal generated in an induction coil can have the positive alternation leading the negative alternation or vice versa. The signals from coils, no matter where positioned, resulting from surface indications will not show this change in polarity of induced signal.

To utilize the foregoing fundamental fact, there is devised the arrangement disclosed in Figs. 2-5 inclusive. In these figures there are shown two sets of coils indicated generally at 22 and 22', the former positioned with their axes longitudinal of the rail, and the latter positioned with their axes transverse of the rail. The set of coils 22 extends, as shown in Fig. 2, entirely across the rail head and beyond the outside corners, while the transverse axis coils 22' occupy substantially the portion of the rail head between the outside corners. With respect to either set of coils, it will be true that an internal defect, such as that indicated at D, will cause a sine wave induced voltage in each coil, but, under conditions to be described hereinafter, the polarity of the signal induced in certain of the coils will be as shown at P in one direction, and the polarity of the signal induced in certain other of said coils will be as shown at P' in the opposite direction. There is thus an instantaneous reversal of signal in the coils. By reversal of signal is meant that the two signals P and P' are generated simultaneously

3

but 180° differing in phase. However, the signal induced in response to surface defects when the coils move through the field will be of the same polarity in all of the coils of each set, 22 and 22'.

In Fig. 2 there are shown coils 22 positioned with their axes longitudinal of the rail. In such coils, it has been found that there is an instantaneous reversal of signal in response to internal defects of a size on the order of 50% or less of the rail head area, but no reversal will occur in response to larger internal defects. In Fig. 3, there are shown coils 22' positioned with their axes transverse of the rail. In such coils, it has been found that there is an instantaneous reversal of signal in response to internal defects of a size on the order of 50% or more of the rail head area, but no useful signal will occur in response to smaller defects. Therefore, by utilizing the two independent sets of coils 22 and 22', there is assured a reversal of signal in response to internal defects of all sizes.

The foregoing fact enables us to distinguish between surface defects and true internal defects so that only the latter may be indicated. For this purpose there is devised the circuit shown in Fig. 5. Here it will be seen that whereas coils 1, 2, etc. of each set 22 and 22' will generate signals P of one polarity in response to an internal defect, the coils, such as 3, 4, etc. of each set 22 and 22' will generate a signal P' of opposite polarity. The coils 1, 2, 3, 4, etc. are shown as part of the set of coils 22 but the same holds true of the coils 1, 2, 3, 4 etc. of the set of coils 22'. The output signals of all of the coils are passed through an isolation and amplification stage as indicated, and then through a separation stage to separate the positive pulses from the negative pulses. In the case of a fissure, therefore, there will be both types of pulse P and P', and the first half cycle of the former will be of one sign while the first half cycle of the other will be of the other sign. Thus, as shown in Fig. 5, the outputs of coils 1 and 2 are positive-negative, while the outputs of coils, such as 3 and 4, are negative-positive. The positive and negative portions of each output are paralleled and the positive outputs are introduced into grid G of a coincidence thyatron 50. The negative outputs which have been paralleled are passed through an inverter 60 so that the output is again positive, and this output is applied to the other grid G' of the coincidence thyatron. If both grids are energized simultaneously with positive signals, the thyatron will fire to actuate pen relay 70 and operate pen P on chart C to indicate the presence of a defect. It will be seen that in the case of a fissure wherein certain of the coils are of one polarity and certain other of the coils are of an opposite polarity that the first half cycle of outputs will be both positive and negative. This means that since the negative output is inverted, there will be two positive outputs simultaneously, one from the initially positive half cycle which is applied to grid G and one from the initially negative half cycle which after inversion is simultaneously applied to grid G'.

Thus a fissure is indicated by reason of the fact that it simultaneously generates signals of opposite polarity in the coils. This enables our device to eliminate the indications which come from surface defects because, as stated hereinbefore, surface defects do not cause change

4

in polarity of signals in the coils. The signals induced in all of the coils arranged entirely across the rail head are all of one polarity. This means that the first half cycle generated in every coil is positive and will be applied to grid G. There is no negative signal in the first half pulse which on inversion can be applied to grid G'. Therefore, there can be no simultaneous energization of grids G and G' and the thyatron will not operate. On the second half cycle of the signals induced by surface defects all of the signal voltages will be negative and after inversion will be applied as a positive voltage on grid G', but this is a half cycle after grid G has been energized and too late to cause operation of the thyatron because there is no simultaneous energization of grids G and G'.

Having described our invention, what we claim and desire to secure by Letters Patent is:

1. A rail flaw detector mechanism comprising means for energizing the rail with flux and inductive means spaced from the rail and movable relative thereto so as to respond to variations in flux, said inductive means comprising a plurality of coils positioned across the rail head whereby certain of said coils will respond to a variation in flux caused by an internal defect in the rail oppositely to the response of certain other of said coils, positive and negative pulses being thus simultaneously generated, means responsive to the simultaneous generation of positive and negative pulses, and indicating means actuated by said responsive means.

2. A rail flaw detector mechanism as specified in claim 1, in which said plurality of coils includes a set of coils positioned with their axes transverse of the rail and another set of coils positioned with their axes longitudinal of the rail.

3. A rail flaw detector mechanism comprising means for energizing the rail with flux and inductive means spaced from the rail and movable relative thereto so as to respond to variations in flux, said inductive means comprising a plurality of coils positioned across the rail head whereby certain of said coils will respond to a variation in flux caused by an internal defect in the rail oppositely to the response of certain other of said coils, positive and negative pulses being thus simultaneously generated, means for rectifying the negative pulses whereby two positive pulses are simultaneously obtained in response to an internal defect, means responsive to the simultaneous generation of said two positive pulses, and indicating means actuated by said responsive means.

4. A rail flaw detector mechanism as specified in claim 3, in which the means responsive to the simultaneous generation of said two positive pulses is a coincidence thyatron.

5. A rail flaw detector mechanism as specified in claim 3, in which the plurality of coils includes a set of coils positioned with their axes transverse of the rail and another set of coils positioned with their axes longitudinal of the rail.

References Cited in the file of this patent

UNITED STATES PATENTS

2,356,968	Barnes et al.	Aug. 29, 1944
2,472,784	Barnes et al.	June 14, 1949
2,477,971	Drake	Aug. 2, 1949