

June 2, 1959

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

2,889,514

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2 Sheets-Sheet 1

FIG. 1

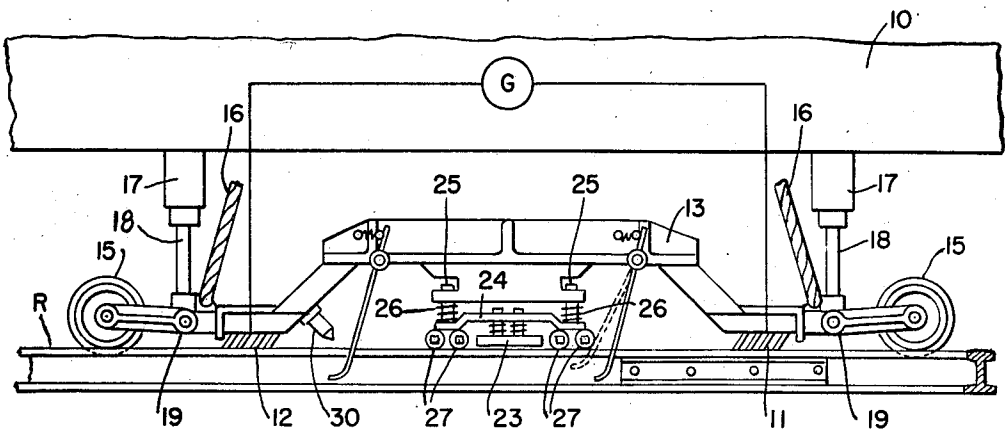


FIG. 2

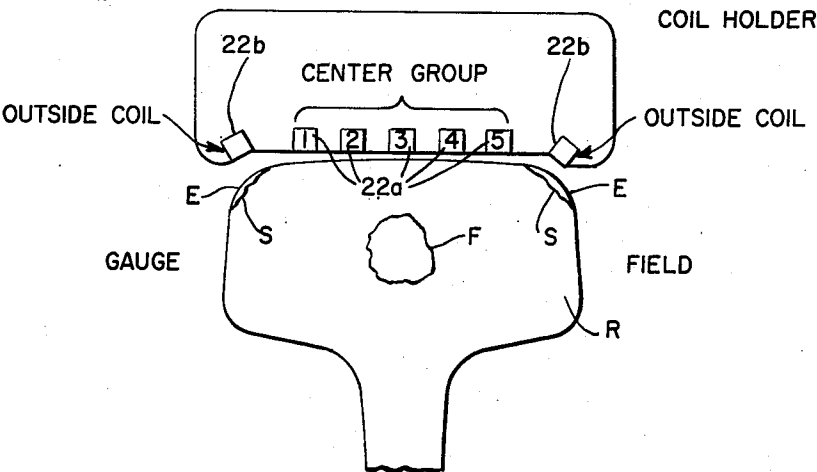
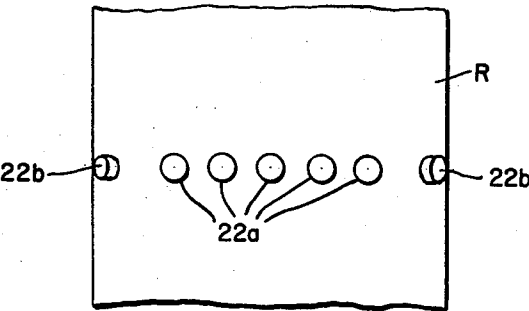


FIG. 3



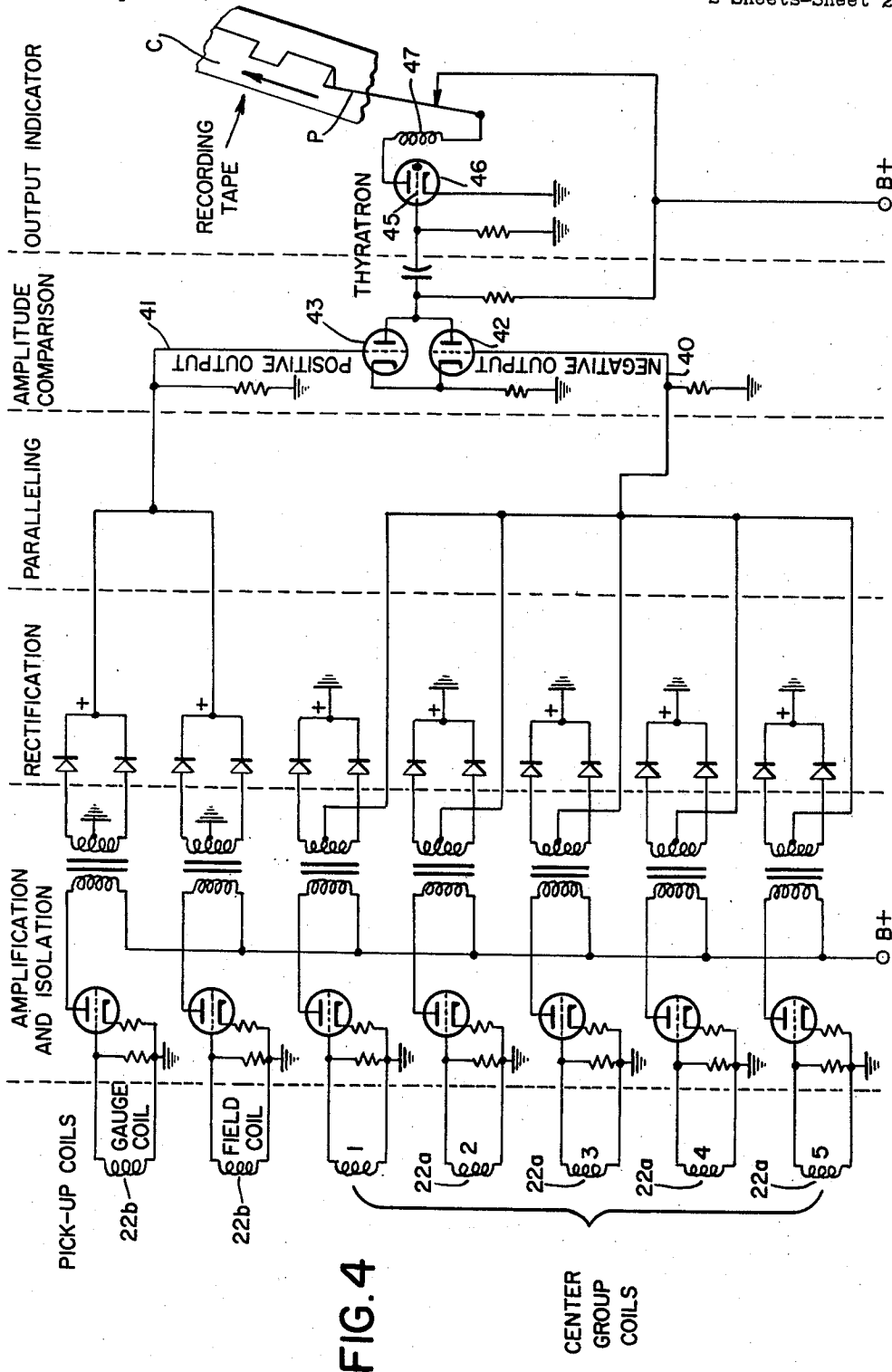
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RAIL FLAW DETECTOR MECHANISM

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4 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 shelly rail, flowed rail, and gauge and field slivers, which are not detrimental to the use of the rail and which it is not the object of the car to detect. These surface irregularities occur principally adjacent the edges of the rail head. 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 portion of a rail head showing in diagrammatic form an arrangement of detector coils as employed in this invention.

Fig. 3 is a plan view of the Fig. 2 arrangement.

Fig. 4 is an electric wiring diagram disclosing the theory of this invention.

Referring to Fig. 1 of the drawings, there are shown the parts of a standard Sperry 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 direct current through each rail from a generator G 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 rails by means such as wheels 15. The current

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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 indicated 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. 4) and to actuate a marking means, such as a 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 respond also to variations in the field caused by such surface irregularities as shelly spots, flowed rail, and gauge and field slivers.

We have therefore devised the following method and means for overcoming the effects of such surface conditions so that only true internal defects will be indicated. For this purpose we take advantage of the fact that the enumerated surface defects occur principally along the outer edges of the rail adjacent the corners E of the rail. We take advantage of the further fact that the presence of an internal defect, such as a transverse fissure F affects the distribution of flux most strongly adjacent the center portion of the rail head, whereas the presence of shelly or flowed rail S affects the electromagnetic distribution principally closely adjacent their position.

Our solution consists in providing a plurality of induction coils 22a, preferably of the vertical axis type and positioned transversely across the rail head as indicated, stopping short of the corner regions E. Adjacent these regions E there are provided coils 22b which may also be of the vertical axis type and positioned with their axes substantially normal to the corners of the rail.

We next provide a circuit shown in Fig. 4 by which only the center coils 22a, but not the outside coils 22b, can operate the indicators. In this circuit it will be seen that the outputs of each of the coils 22a and 22b are separately amplified and isolated in the amplification and isolation stage noted. The next step is to rectify the outputs of the coils, the outputs of coils 22a being oppositely rectified relative to the outputs of coils 22b. The outputs of coils 22a are rectified to obtain negative outputs which are then paralleled as one negative output retaining amplitude information from the coils. Similarly, the outputs of coils 22b are rectified to obtain positive outputs which are paralleled to obtain one positive output. The total negative output from coils 22a is obtained at 40, while the total positive output from coils 22b is obtained at 41. These total outputs are then compared in a comparison stage by introducing them into a pair of tubes 42,

43 whose outputs are arranged for an algebraic addition. The total outputs at 40 and 41 are inverted in the comparison stage 42, 43 and applied to the grid 45 of thyatron 46. A positive voltage of predetermined magnitude applied to grid 45 will cause discharge of the thyatron to operate a pen relay 47 to actuate pen P on chart C.

It is apparent that only a predominant positive output from the comparison tubes 42, 43 can operate the thyatron, and this means that due to inversion in the comparator stage for both inputs only the output 40 from the center group of coils 22a can operate the thyatron, provided the amplitude of output 40 exceeds the amplitude of output 41 by a predetermined amount. If, therefore, no fissure is present, the outside coils 22b will, in response to shelly or flowed conditions of the rail or to the presence of slivers, produce a positive output at 41 which, being inverted at 43, will produce a negative voltage incapable of firing the thyatron or actuating the recorder. The center coils 22a will not be substantially affected by these conditions. If an internal fissure is present, it will yield a negative output 40 which, being inverted at 42, will yield a positive output which can operate thyatron 46 if the input is of sufficient magnitude. The coils 22b will not be substantially affected by fissures in the center portion of the rail head. Similarly, if a fissure occurs in the region of shelly and flowed rail, the fissure will be indicated if the output from the center coils at 40 is sufficiently greater than the output from the outside coils to produce a positive voltage of at least predetermined magnitude at the thyatron 46.

There is thus achieved a system wherein false indications heretofore detected by the rail fissure detector mechanism, and due to shelly and flowed rail portions as well as to gauge and field slivers, will no longer be indicated, thus enabling the mechanism to test more rapidly and more accurately. Furthermore, there is provided a system which enables a substantial number of internal defects to be detected even in the present of such surface irregularities.

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 including a plurality of coils arranged across the rail head and coating principally with the portion of the rail head between the outside corners and affected relatively strongly by internal defects in the rail and relatively weakly by rail surface conditions adjacent the outside corners of the rail, said inductive means including also a plurality of coils coating principally with the outside corners of the rail where they are affected relatively strongly by surface conditions adjacent the outside corners and relatively weakly by internal defects in the rail, means for comparing the output voltages from said first and second sets of coils, indicating means, and means for actuating said indicating means, said actuating means including means responsive to an excess voltage from said comparing means due to said first set of coils.

2. 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 including a plurality of coils arranged across the rail head and coating principally with the portion of the rail head between the outside corners and affected relatively strong-

ly by internal defects in the rail and relatively weakly by rail surface conditions adjacent the outside corners of the rail, said inductive means including also a plurality of coils coating principally with the outside corners of the rail where they are affected relatively strongly by surface conditions adjacent the outside corners and relatively weakly by internal defects in the rail, means for rectifying the output voltages of said first and second sets of coils to yield output voltages of opposite sign, means for comparing the output voltages of opposite sign, indicating means, and means for actuating said indicating means by the output from said comparing means, said actuating means including means responsive only to the output of said comparing means due to excess voltage from said first set of coils.

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 including a plurality of coils arranged across the rail head and coating principally with the portion of the rail head between the outside corners and affected relatively strongly by internal defects in the rail and relatively weakly by rail surface conditions adjacent the outside corners of the rail, said inductive means including also a plurality of coils coating principally with the outside corners of the rail where they are affected relatively strongly by surface conditions adjacent the outside corners and relatively weakly by internal defects in the rail, means for rectifying the output voltages of said first set of coils to yield a negative voltage, means for rectifying the output voltages of said second set of coils to yield a positive voltage, means for comparing the rectified voltages, indicating means, and means for actuating the indicating means by the output from said comparing means, said actuating means including means responsive only to the output of said comparing means due to excess voltage from said first set of coils.

4. 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 including a plurality of coils arranged across the rail head and coating principally with the portion of the rail head between the outside corners and affected relatively strongly by internal defects in the rail and relatively weakly by rail surface conditions adjacent the outside corners of the rail, said inductive means including also a plurality of coils coating principally with the outside corners of the rail where they are affected relatively strongly by surface conditions adjacent the outside corners and relatively weakly by internal defects in the rail, means for rectifying the output voltages of said first set of coils to yield a negative voltage, means for rectifying the output voltages of said second set of coils to yield a positive voltage, means for comparing and inverting the rectified voltages, indicating means and means for actuating the indicating means by the output from said comparing means, said actuating means including means responsive only to positive voltage.

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