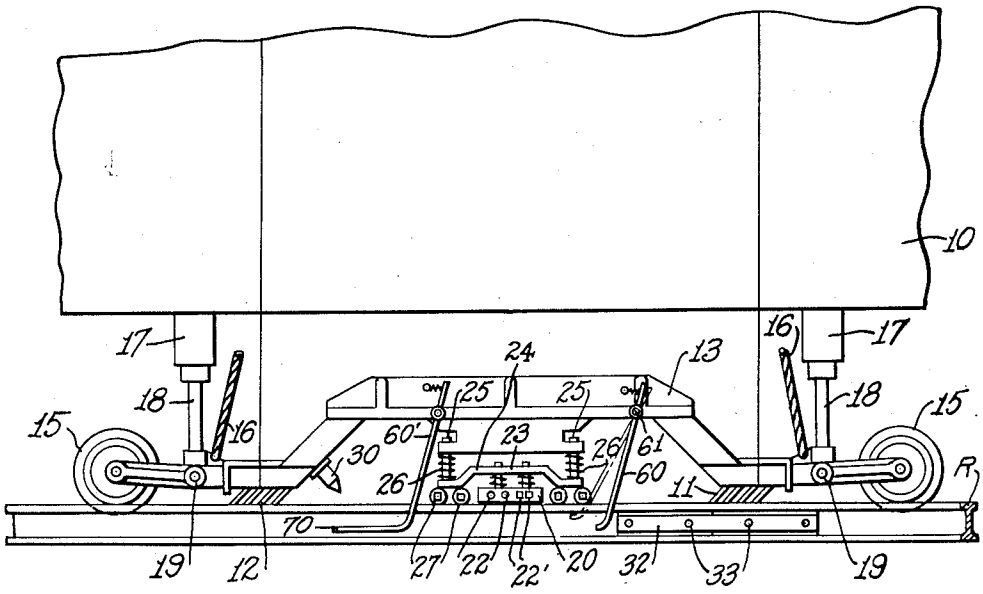
March 27, 1951 H. C. DRAKE 2,546,256

RAIL FLAW DETECTOR MECHANISM

Filed July 7, 1948 2 Sheets-Sheet 1

FIG. 1



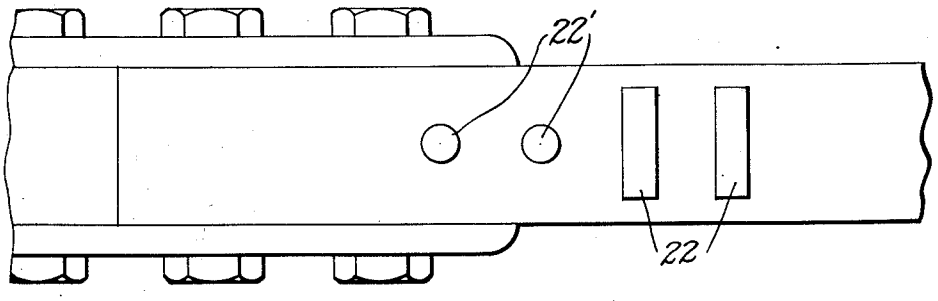


FIG. 3

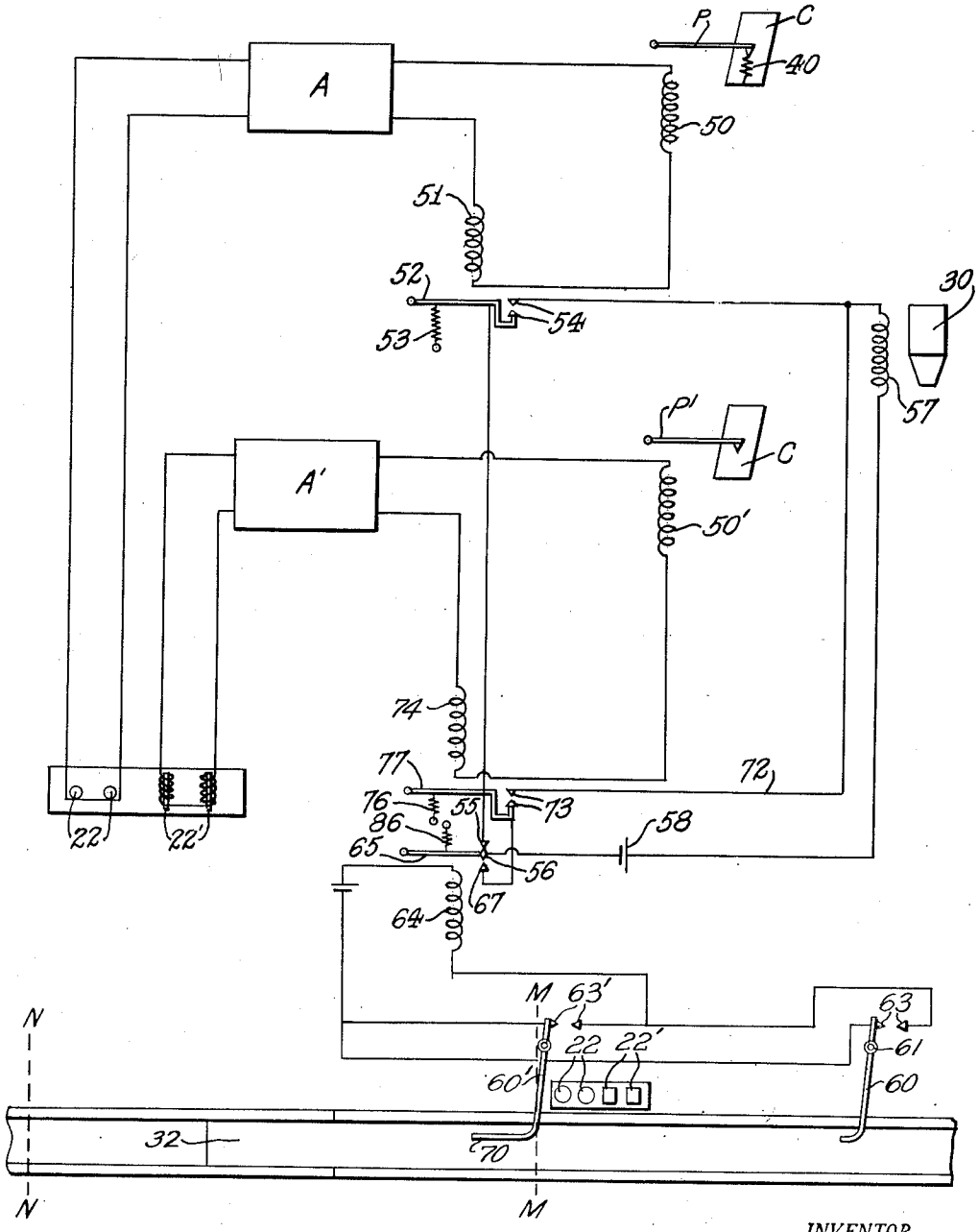
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RAIL FLAW DETECTOR MECHANISM

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FIG. 2



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RAIL FLAW DETECTOR MECHANISM

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Application July 7, 1948, Serial No. 37,390

7 Claims. (Cl. 175—183)

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This invention relates to rail flaw detector mechanism and is particularly designed for application upon the type of detector mechanism employed on the Sperry rail flaw detector car. This invention is a continuation in part of my co-pending application Serial No. 773,704 filed September 12, 1947, now abandoned. This car operates upon the principle of energizing the rail with flux, as, for instance, by 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, and so forth, which joints constitute in themselves irregularities in the rail which will cause variations in the flux in the same manner as an internal fissure. Therefore as the detector car rides along the rail, the detector mechanism in passing over a rail joint gives rise to a large number of closely bunched indications not distinguishable from one another. As a result, should an internal fissure occur in the rail within the region of the angle bar or closely adjacent to the ends of the angle bar it would be impossible to distinguish such fissure from any other indications.

It is the principal object of this invention to provide a method and means for enabling a detector car to detect internal fissures within the region affected by the angle bar.

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 my invention applied thereto.

Fig. 2 is an electric wiring diagram of one embodiment of this invention.

Fig. 3 is a plan view of a portion of a rail at the joint illustrating the theory of this invention.

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 energizing the rail with flux, as, for instance, 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

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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 positioned with their axes horizontal and transverse to the rail head and 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 member 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 or joint 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. The irregularities of the angle bar will cause the detector coils to pick up a large number of closely bunched indications as shown at 40. This is due to the fact that the current in the rail is obliged to enter and leave the joint bar, and therefore there are transition points at the ends of the joint bar where there is a sharp change

in the direction of current flow and therefore in the flux at these points. Since the chart is driven from the car axle at the rate of approximately $\frac{1}{16}$'' to the foot of travel of the car, and since the angle bar region extends about 2', the bunched indications 40 will extend about $\frac{1}{8}$'' within which space will be packed a large number of indications. It can readily be understood that should an internal defect in the rail occur in this region, the indication which it would produce would be indistinguishable from the bunched indications 40. As a consequence no attempt was heretofore made to detect internal defects in the joints of the rail within the angle bar region. However internal defects do occur in this region and it is desirable to detect them if possible.

To achieve the result described above applicant employs the following mechanism:

In addition to the detector coils 22 which are positioned with their axes horizontal and transverse with respect to the rail head, I employ a pair of coils 22' in advance of coils 22 and positioned with their axes vertical to the rail head. These coils are arranged in tandem, similar to coils 22, and their output is designed to be amplified either by a separate amplifier A' or by a separate channel in amplifier A. The amplified output is caused to energize a coil 50 which actuates a pen P' either on a separate chart or on the same chart C as pen P. The pen P as shown is actuated by coil 50 energized from the amplifier A which amplifies the output of coils 22. The coils 22 extend laterally of the rail head for a substantial distance so that they are affected by the distortion in the electromagnetic field caused by the ends of the joint bars 32 at the outer edges of the rail head. The diameter of coils 22', i. e., their lateral dimension, is made small relative to the lateral dimension of the rail head, and furthermore these coils 22' are positioned substantially centrally of the rail head so that they will be substantially unaffected by the distortions in the field set up by the ends of the joint bars. Fissures, being located within the rail head, are seldom positioned exactly centrally of the rail head and, therefore, there will be distortion of the flux in the central portion of the rail head in response to a fissure. Thus, the vertical coils 22' will respond to practically all fissures within the joint bar area while being substantially unaffected by the joint bars themselves.

The amplified output of amplifier A in addition to energizing coil 50, energizes also coil 51 which attracts its armature 52 against the action of a spring 53 to close a set of contacts 54 and thus close a circuit which includes contacts 55, 56, battery 58 and coil 57 which energizes the paint gun 30. If the last described circuit 54, 55, 56 and 57 remained effective when coils 22 were passing through the region affected by the rail joint, the paint gun would be almost continuously energized due to the fact that the variations in flux caused by the irregularities of the joints affect coils 22 in the same manner and to the same extent as an internal defect. Thus not only would no useful purpose be served by such paint gun energization while the detector coils 22 were passing through the region affected by the joint, but paint would be unnecessarily used up since it would be impossible to distinguish a paint mark due to an internal fissure from those due to the rail joint irregularities.

Therefore I have provided the following arrangement: As the coils 22 approach the region of flux indicated at position N—N a joint finger 60 pivoted at 61 and in engagement with the rail head will make contact with the joint bar 32 and will be turned around its pivot 61 to close a set of contacts 63 to energize a coil 64 which will attract armature 65 against the action of spring 66 to break engagement between contacts 55 and 56 and thus open the paint gun circuit so that contacts 54 can no longer control the paint gun. This means that regardless of the signal generated by coils 22 in the region affected by the joint no energization of the paint gun due to this signal will take place. The coils 22 are maintained ineffective to operate the paint gun until said coils have passed beyond the position M—M where the joint region ends. For this purpose the carriage may be provided with front and rear fingers 60, 60' the rear finger being adapted to engage the joint bar before the front finger leaves the bar and the rear finger being provided with an extension 70 designed to maintain the rear joint finger in tilted position to close contact 63 until coils 22 have reached position M—M.

With the above described construction the coils 22 are unable to operate the paint gun throughout the period during which said coils are traveling from position N—N to position M—M. The next part of my invention consists in causing coils 22' to take over control and operate the paint gun 30 during the interval that the coils 22 are ineffective to operate said paint gun. For this purpose when the leading joint finger 60 closes contacts 63 to energize coil 64 and break engagement between contacts 55 and 56, engagement is made between contact 56 and contact 67. This establishes a circuit through paint gun coil 57, lead line 72 and contacts 73 which are controlled by coil 74 energized from amplifier A' which amplifies the signal generated by coils 22'. Since coils 22' are insensitive to rail joint irregularities but are sensitive to internal defects, particularly large defects, the tension of spring 76 which restrains armature 77 can be made such that for a given output of amplifier A' coil 74 will be energized to close contacts 73 and thus energize the paint gun. Any energization of the paint gun in the region affected by the joint must therefore be due to the output of coils 22' and hence must be due to an internal fissure in this region since the coils 22' are insensitive to rail joint irregularities but are sensitive to internal defects, and spring 76 is so tensioned that contacts 73 will be closed only by an output of predetermined strength which can be caused only by a fissure.

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 which include joint bars, said car having means for energizing the rail with flux, means responsive to variations in said flux caused by defects in the rail, said responsive means responding substantially also to variations in said flux caused by the ends of the joint bars, a second means responsive to variations in said flux caused by defects in the rail, said second responsive means being relatively unresponsive to variations in said flux caused by the ends of the joint bars, an indicator, means whereby said first responsive means is normally effective to control said indicator and said second responsive means is normally ineffective to control said indicator, means actuated for the interval that said first and second responsive means are passing through the region of flux affected by the joint, and means

actuated by said last-named means for rendering said first responsive means ineffective to control said indicator and for rendering said second responsive means effective to control said indicator in the region of a joint.

2. In a rail flaw detector car adapted to travel over rails connected by joints which include joint bars, said car having means for energizing the rail with flux, means responsive to variations in said flux caused by defects in the rail, said responsive means responding substantially also to variations in said flux caused by the ends of the joint bars, a second means responsive to variations in said flux caused by defects in the rail, said second responsive means comprising an induction coil positioned with its axis vertical with respect to the rail head, said coil having its lateral dimension small relative to the width of the rail head whereby said coil is relatively unresponsive to variations in said flux caused by the ends of the joint bars, an indicator, means whereby said first responsive means is normally effective to control said indicator and said second responsive means is normally effective to control said indicator, means responsive to joints, and means actuated by said joint-responsive means for rendering said first responsive means ineffective to control said indicator and for rendering said second responsive means effective to control said indicator in the region of a joint.

3. In a rail flaw detector car adapted to travel over rails connected by joints which include joint bars, said car having means for energizing the rail with flux, means responsive to variations in said flux caused by defects in the rail, said responsive means responding substantially also to variations in said flux caused by the ends of the joint bars, a second means responsive to variations in said flux caused by defects in the rail, said second responsive means comprising an induction coil positioned with its axis vertical with respect to the rail head, said coil having its lateral dimension small relative to the width of the rail head and being positioned substantially centrally of the rail head whereby said coil is relatively unresponsive to variations in said flux caused by the ends of the joint bars, an indicator, means whereby said first responsive means is normally effective to control said indicator and said second responsive means is normally ineffective to control said indicator, means responsive to joints, and means actuated by said joint-responsive means for rendering said first responsive means ineffective to control said indicator and for rendering said second responsive means effective to control said indicator in the region of a joint.

4. In a rail flaw detector car adapted to travel over rails connected by joints which include joint bars, said car having means for energizing the rail with flux, means comprising a plurality of induction coils positioned with their axes horizontal with respect to the rail head, said coils being responsive to variations in said flux caused by defects in the rail, said responsive means responding substantially also to variations in said flux caused by the ends of the joint bars, a second means responsive to variations in said flux caused by defects in the rail, said second responsive means comprising a plurality of induction coils positioned with their axes vertical with respect to the rail head, said last-named coils having their lateral dimension small relative to the width of the rail head whereby said coils are relatively unresponsive to variations in said flux caused by the ends of the joint bars, an indicator, means

whereby said first responsive means is normally effective to control said indicator and said second responsive means is normally ineffective to control said indicator, means responsive to joints, and means actuated by said joint responsive means for rendering said first responsive means ineffective to control said indicator and for rendering said second responsive means effective to control said indicator in the region of a joint.

5. In a rail flow detector car adapted to travel over rails connected by joints which include joint bars, said car having means for energizing the rail with flux, means comprising a plurality of induction coils positioned with their axes horizontal with respect to the rail head, said coils being responsive to variations in said flux caused by defects in the rail, said responsive means responding substantially also to variations in said flux caused by the ends of the joint bars, a second means responsive to variations in said flux caused by defects in the rail, said second responsive means comprising a plurality of induction coils positioned with their axes vertical with respect to the rail head, said last-named coils having their lateral dimension small relative to the width of the rail head and being positioned substantially centrally of the rail head whereby said coils are relatively unresponsive to variations in said flux caused by the ends of the joint bars, an indicator, means whereby said first responsive means is normally effective to control said indicator and said second responsive means is normally ineffective to control said indicator, means responsive to joints, and means actuated by said joint responsive means for rendering said first responsive means ineffective to control said indicator and for rendering said second responsive means effective to control said indicator in the region of a joint.

6. In a rail flaw detector car adapted to travel over rails connected by joints which include joint bars, said car having means for energizing the rail with flux, means comprising a plurality of induction coils positioned with their axes horizontal with respect to the rail head, said coils being responsive to variations in said flux caused by defects in the rail, said responsive means responding substantially also to variations in said flux caused by the ends of the joint bars, a second means responsive to variations in said flux caused by defects in the rail, said second responsive means comprising a plurality of induction coils positioned with their axes vertical with respect to the rail head, said last-named coils having their lateral dimension small relative to the width of the rail head whereby said coils are relatively unresponsive to variations in said flux caused by the ends of the joint bars, a paint gun, means whereby said first responsive means is normally effective to control said paint gun and said second responsive means is normally ineffective to control said paint gun, means responsive to joints, and means actuated by said joint responsive means for rendering said first responsive means ineffective to control said paint gun and for rendering said second responsive means effective to control said paint gun in the region of a joint.

7. In a rail flaw detector car adapted to travel over rails connected by joints which include joint bars, said car having means for energizing the rail with flux, means comprising a plurality of induction coils positioned with their axes horizontal with respect to the rail head, said coils being responsive to variations in said flux caused

by defects in the rail, said responsive means responding substantially also to variations in said flux caused by the ends of the joint bars, a second means responsive to variations in said flux caused by defects in the rail, said second responsive means comprising a plurality of induction coils positioned with their axes vertical with respect to the rail head, said last-named coils having their lateral dimension small relative to the width of the rail head and being positioned substantially centrally of the rail head whereby said coils are relatively unresponsive to variations in said flux caused by the ends of the joint bars, a paint gun, means whereby said first responsive means is normally effective to control said paint gun and said second responsive means is normally ineffective to control said paint gun, means responsive to

joints, and means actuated by said joint responsive means for rendering said first responsive means ineffective to control said paint gun and for rendering said second responsive means effective to control said paint gun in the region of a joint.

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