Oct. 24, 1950 H. C. DRAKE 2,527,002

RAIL FLAW DETECTOR RECORDING MECHANISM

Filed Aug. 23, 1949 2 Sheets-Sheet 1

FIG. 1

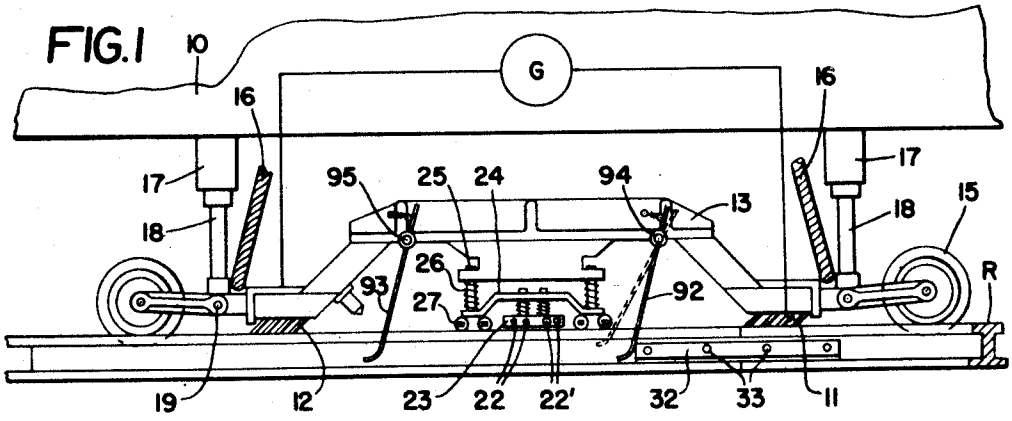


FIG. 3

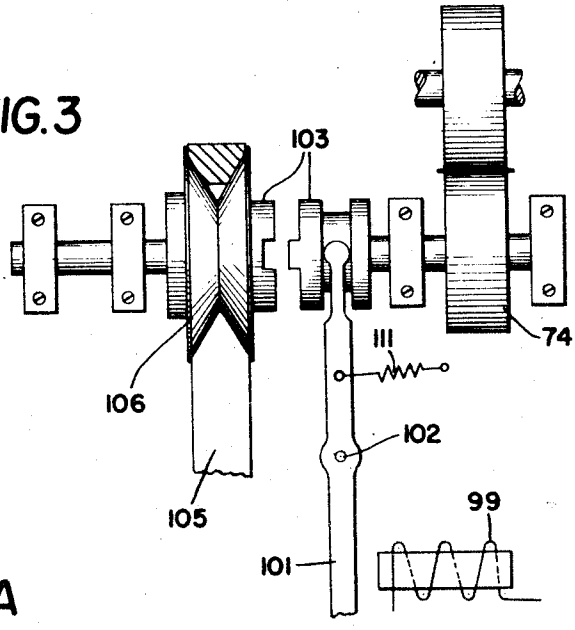
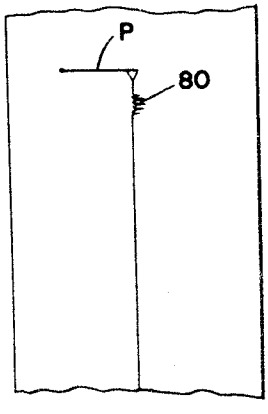


FIG. 4A



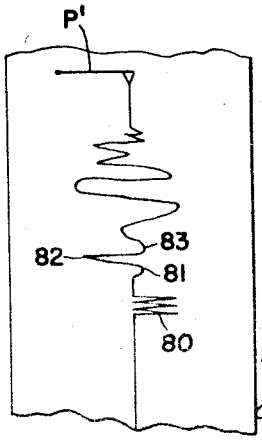


FIG. 4B

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RAIL FLAW DETECTOR RECORDING MECHANISM

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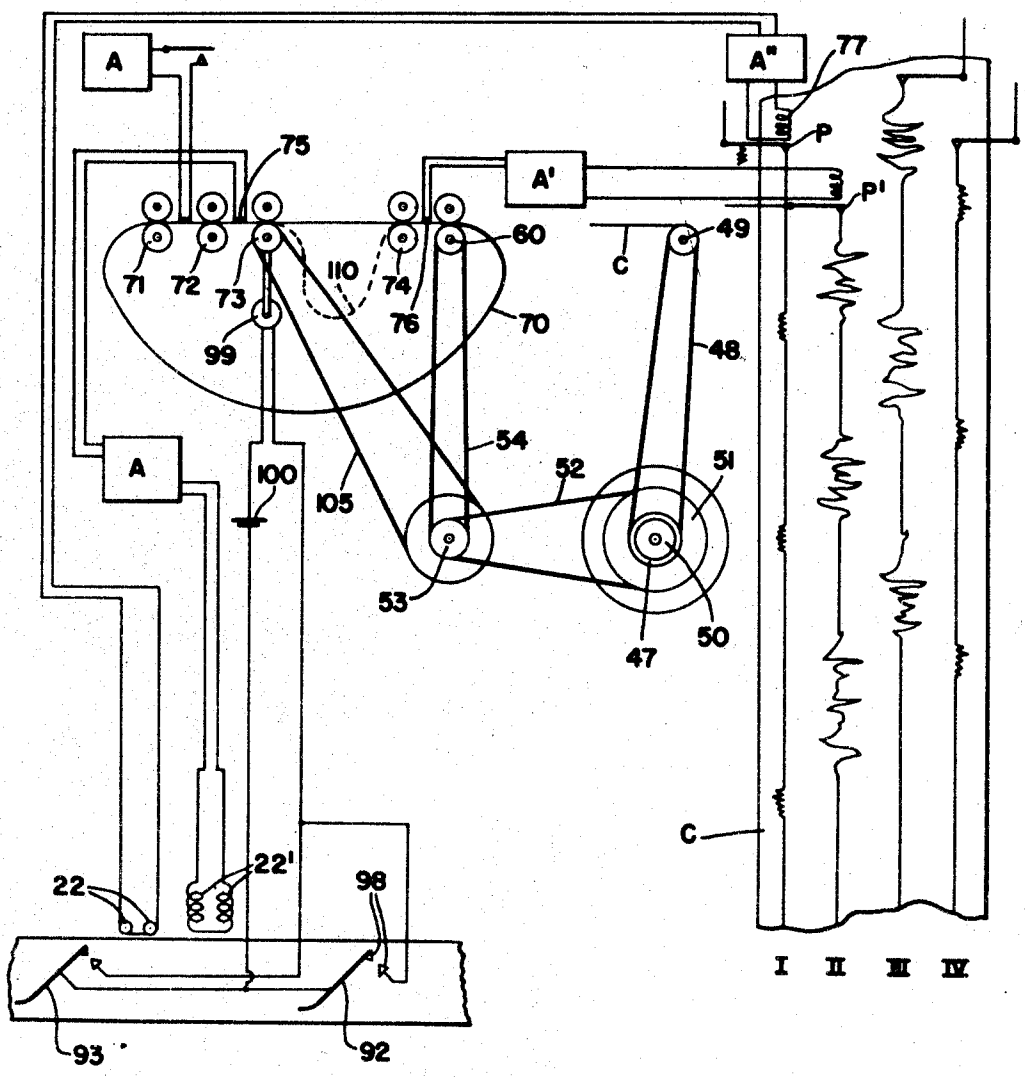


FIG. 2

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RAIL FLAW DETECTOR RECORDING MECHANISM

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Application August 23, 1949, Serial No. 111,889

6 Claims. (Cl. 346—43)

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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 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, etc., 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 on a recording tape, which indications are not distinguishable from one another nor from the indications which may be caused by an internal defect in the rail. As a result, should an internal fissure occur in the rail within the region of the angle bar or 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 assembly view of mechanism for effecting accelerated movement of an auxiliary tape together with a portion of an indicating chart.

Fig. 3 is an enlarged view of an overrunning clutch employed in the Fig. 2 mechanism.

Figs. 4A and 4B are portions of an indicating chart illustrating diagrammatically the principle underlying 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 a current through each rail from a generator G within the car body, supplying current

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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 flux responsive mechanism which may take the form of a plurality of pairs of opposed induction coils 22, 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, 22' normally cut the same number of lines of force, but on entering a region of flaw, first one coil of each pair and then the other will cut a different number of lines of force to generate a differential E. M. F. which may be caused to actuate (by means to be described hereinafter) pens P and P' operating on a chart C. At the same time that the pens are 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 flux responsive members 22 and 22' to compensate for the movement of the car and for the lag in operation of the paint gun.

Since the mechanism described above is duplicated for the other rail there will be actuated a total of four pens all of which may co-act with the same chart C. The pens will draw lines I and II for one rail and lines III and IV for the other rail. The chart may be driven from the car axle as will be described more fully hereinafter so that the pens normally draw four straight lines along the chart except where the electromagnetic field is distorted either by fissures within the rail or by the irregularities introduced by the rail joints.

As stated in the introduction hereto, the joints

which hold the rails together comprise angle bars 32, bolts 33, and additional members, all of which serve 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 variations in the electromagnetic field and this in turn will cause the pens to record upon the chart C a large number of closely bunched indications. Since the current deflection caused by the angle bar commences a considerable distance in advance of the bar and extends its influence for a similar distance beyond the leaving end of the bar, it will be understood that there is a considerable portion of rail within which it will be difficult to discover any internal defects because any indication of variation in flux caused by the internal defect will be merged with, and be indistinguishable from, the large number of indications set up by the angle bar within the region affected thereby. However internal defects do occur in this region and it is desirable to detect them.

To achieve the result described above, applicant resorts to the following steps: First, the plurality of pairs of detector coils 22 and 22' are arranged in tandem and the coils of each pair are similarly arranged. However, whereas coils 22 are positioned with their axes transverse of the longitudinal dimension of the rail, coils 22' are arranged with their axes normal to the rail tread. Furthermore, the diameter of coils 22' is relatively small compared with the rail and these coils are positioned substantially centrally of the rail head so as to be relatively little affected by the lateral distortion of the electromagnetic flux caused by the rail joint. Therefore coils 22' will be able to test into the angle bar region without being appreciably affected by the distortion.

The second step of this method consists in causing the flux variations set up in the region of a joint to be recorded on an accelerated tape and then transferring the record from the tape to the standard indicating chart which operates at a relatively slow speed. In order to accomplish this result there is provided a normal drive from the car axle 50 to the indicating chart C by means such as pulley 47, belt 48 and rewind roller 49. At the same time there is driven through pulley 51, belt 52, pulley 53, belt 54, and shaft 60 an endless belt type magnetic tape or wire 70 which passes between series of rollers 71, 72, 73, 74. Impressions on the magnetic tape 70 are made by the vertical coils 22' which pick up the variations in the flux and after said variations are amplified by an amplifier A, are caused to make impressions on the tape by means of an energizing coil 75 which is energized by the output of amplifier A. The impressions made on the magnetic tape 70 by the energizing coil 75 are picked up by pick-up or receiving coil 76 which may provide the input to an amplifier A' of the Brush oscillograph type whose output will vary in accordance with the variations of the pick-up coil 76 to operate pen P' a distance proportionate to the output of amplifier A'. In this respect the indication made by pen P' differs from the indication made by pen P. The latter is actuated a constant distance at each actuation provided the pen relay 77 is energized with a sufficient voltage to attract the pen armature against the action of spring 78. The energizing voltage is derived from the output of amplifier A'' whose input is the differential voltage generated by coils 22.

As thus far described the impressions made upon magnetic tape 70 in response to variations in the electromagnetic field picked up by the coils 22' will be discharged on the chart C at the same rate relative to movement of the chart as the impressions made by pen P since both magnetic tape 70 and chart C are being driven at their relatively slow speeds. This, however, would be inadequate to give a useful indication at the joints sufficient to enable one to detect possible internal fissures in the region of the joint. As stated in the introduction hereto, the multiplicity of parts which comprise the joint results in a multiplicity of variations in the magnetic field which are so closely bunched that an indication such as shown at 80 in Fig. 4A is obtained by the action of pen P. The pen P' which is actuated proportionately to the output of amplifier A' would yield an indication 80' (Fig. 4B) similar to 80. However, if the indication made by pen P' could be spread out in the direction of movement of chart C, it would be possible to detect the presence of a fissure in the midst of indications due to the joint parts by reason of the fact that a fissure yields a characteristic and readily identifiable indication as shown graphically in Fig. 4B. This indication in terms of voltage output comprises a small positive output 81, followed by a large negative output 82, which in turn is followed by a small positive output 83. This characteristic output from amplifier A' in response to the presence of a fissure makes it possible to locate a fissure within the multiplicity of indications caused by a joint provided the indications made by pen P' can be spread out in the direction of movement of chart C.

To obtain such spread-out indication by pen P' I employ the method of accelerating the magnetic tape 70 in the region of a joint so that the flux variations picked up by coils 22' will cause coil 75 to impress varying magnetic fluxes on the rapidly moving tape 70, and then causing the tape 70 to move past the receiving coil 76 at a relatively slow rate so that it takes a relatively longer length of chart C to record the impressions made by coil 75 while the tape 70 was accelerated. In other words, while the coils 22' are passing through the region of a joint they are impressing their variations on the rapidly moving tape and these impressions are then being reproduced on the slowly moving tape so that the net result is a spread-out indication of the variations in the joint area. For this purpose there is provided a pair of pivoted joint fingers 92 and 93, pivoted at 94 and 95 on the current brush carriage 13 in advance of and to the rear of the current brush carriage. Finger 92 is positioned sufficiently in advance of coils 22' so as to engage the projecting angle bar just before coils 22' enter the region of flux affected by the joint. Similarly, finger 93 is positioned sufficiently to the rear of coils 22 so that said coils will have passed beyond the region of flux affected by the angle bar by the time finger 93 drops off the leaving end of the angle bar. Finger 93 is positioned so as to engage the angle bar before finger 92 leaves the bar. When finger 92 engages the bar it will close a set of contacts 98 which will close a circuit through a relay 99, said circuit including a battery 100, to cause the relay 99 to attract armature 101 (see Fig. 3) in the form of a lever pivoted at 102 to cause clutch members 103 to engage. Prior to engagement of clutch parts 103, the car axle 50 drives the shaft 60 at the predetermined slow

rate relative to the chart C. The driving of shaft 60 causes the magnetic tape to be driven at this relatively slow speed. However, when finger 92 engages the angle bar to close contacts 98, clutch 103 is engaged and the portion of the tape 70 to the rear of the driving shaft 60 is now driven at a more rapid rate, on the order of eight times the rate of shaft 60 by reason of the multiplying shaft and pulley drive 105, 106. The portion of the tape to the rear of shaft 60 will therefore be driven at the accelerated rate causing the tape to be drawn past the impressing coil 75 at the accelerated rate and further causing the portion of the tape to the rear of shaft 60 to form a loop 110. The clutch parts 103 will remain engaged as long as fingers 92 and 93 ride on the angle bar. When finger 93 leaves the angle bar, relay 99 will be de-energized and spring 111 will open the clutch to render the fast drive of the magnetic tape through roller 73 ineffective. Meanwhile the slow drive of magnetic tape 70 has continued past the pick-up coil 76 and will continue until the loop 110 has been absorbed. This means that all the impressions made on the accelerated portion of the magnetic tape in the loop 110 will be impressed on chart C but in a spread-out form since the impressions on chart C will take place in a linear distance corresponding to the length of the loop 110.

Thus the spread-out impressions made by pen P' are obtained on chart C and it is therefore possible to recognize the characteristic indication 81, 82, 83 caused by a fissure even when it occurs within the multiplicity of other indications caused by the joint parts.

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, comprising means for energizing the rail with flux, means responsive to variations in said flux caused by defects in the rail, said responsive means responding also to variations in said flux caused by the region of a joint, means responsive only to the region of a joint, means including a moving chart for recording variations in flux detected by said first responsive means, means for storing up at a rate relatively rapid with respect to the movement of the chart the successive flux variations detected by said first responsive means, means for recording on said chart successively said stored up flux variations at a rate relatively slow with respect to the rate of storing up of said flux variations, and means actuated by said second joint responsive means while responding to a joint for rendering effective said means for storing up flux variations at a relatively rapid rate.

2. In a rail flaw detector car adapted to travel over rails connected by joints, comprising means for energizing the rail with flux, means responsive to variations in said flux caused by defects in the rail, said responsive means responding also to variations in said flux caused by the region of a joint, means responsive only to the region of a joint, said car having a chart, means for driving said chart at a relatively slow speed with respect to the speed of the car, a pen cooperating with said chart, relay means for actuating said pen through a constant distance by said first responsive means in response to flux variations in excess of a predetermined degree of flux variation, a second pen cooperating with said chart, means for actuating said second pen in proportion to flux variations in said first responsive means, means for storing up at a relatively rapid rate the successive flux variations detected by said first responsive means, means including said second pen for recording successively said stored up flux variations on said chart at a relatively slow rate, and means actuated by said second joint responsive means while responding to a joint for rendering effective said means for storing up flux variations at a relatively rapid rate.

3. In a rail flaw detector car adapted to travel over rails connected by joints, comprising means for energizing the rail with flux, means responsive to variations in said flux caused by defects in the rail, said responsive means responding also to variations in said flux caused by the region of a joint, means responsive only to the region of a joint, means for recording variations in flux detected by said first responsive means, a magnetic recorder comprising a magnetizable tape, an impressor actuated by said flux responsive means for impressing flux variations on said tape, and a pick-up responsive to the flux variations on said tape, a recorder actuated by the output of said pick-up, means for driving said tape past said receiver at a constant relatively slow rate, normally ineffective means for driving said tape past the impressor at a relatively rapid rate, and means whereby said last-named means is rendered effective by said second joint responsive means while responding to a joint.

4. In a rail flaw detector car adapted to travel over rails connected by joints, comprising means for energizing the rail with flux, means responsive to variations in said flux caused by defects in the rail, said responsive means responding also to variations in said flux caused by the region of a joint, means responsive only to the region of a joint, said car having a chart, means for driving said chart at a relatively slow speed with respect to the speed of the car, a pen cooperating with said chart, means for actuating said pen through a constant distance by said first responsive means in response to flux variations in excess of a predetermined degree of flux variation, a second pen cooperating with said chart and adapted to be actuated in proportion to flux variations, a magnetic recorder comprising a magnetizable tape, an impressor actuated by said flux responsive means for impressing flux variations on said tape, and a pick-up responsive to the flux variations on said tape, means including said second pen actuated by the output of said pick-up, means for driving said tape past said pick-up at the same rate as said chart, normally ineffective means for driving said tape past the impressor at a relatively rapid rate, and means whereby said last-named means is rendered effective by said second joint responsive means while responding to a joint.

5. In a rail flaw detector car adapted to travel over rails connected by joints, comprising means for energizing the rail with flux, means responsive to variations in said flux caused by defects in the rail, said responsive means responding also to variations in said flux caused by the region of a joint, means responsive only to the region of a joint, means for recording variations in flux, a magnetic recorder comprising an endless magnetizable tape, an impressor actuated by said flux responsive means for impressing flux variations on said tape, and a pick-up responsive to the flux variations on said tape, a recorder actuated by the output of said pick-up, means for driving said tape past said pick-up at a constant relatively slow rate, nor-

mally ineffective means for driving said tape past the impressor at a relatively rapid rate, means whereby said last-named means is rendered effective by said second joint responsive means while responding to a joint, and flux erasing mechanism in advance of the impressor.

6. In a rail flaw detector car adapted to travel over rails connected by joints, comprising means for energizing the rail with flux, means responsive to variations in said flux caused by defects in the rail, said responsive means responding also to variations in said flux caused by the region of a joint, means responsive only to the region of a joint, said car having a chart, means for driving said chart at a relatively slow speed with respect to the speed of the car, a pen cooperating with said chart, means for actuating said pen through a constant distance by said first responsive means in response to flux variations in excess of a predetermined degree of

flux variation, a second pen cooperating with said chart and adapted to be actuated in proportion to flux variations, a magnetic recorder comprising an endless magnetizable tape, an impressor actuated by said flux responsive means for impressing flux variations on said tape, and a pick-up responsive to the flux variations on said tape, a recorder including said second pen actuated by the output of said pick-up, means for driving said tape past said pick-up at the same rate as said chart, normally ineffective means for driving said tape past the impressor at a relatively rapid rate, means whereby said last-named means is rendered effective by said second chart responsive means while responding to a joint, and flux erasing means positioned in advance of the impressor.

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No references cited.