Oct. 24, 1950 H. C. DRAKE 2,527,000

RAIL FLAW DETECTOR RECORDING MECHANISM

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FIG. 1

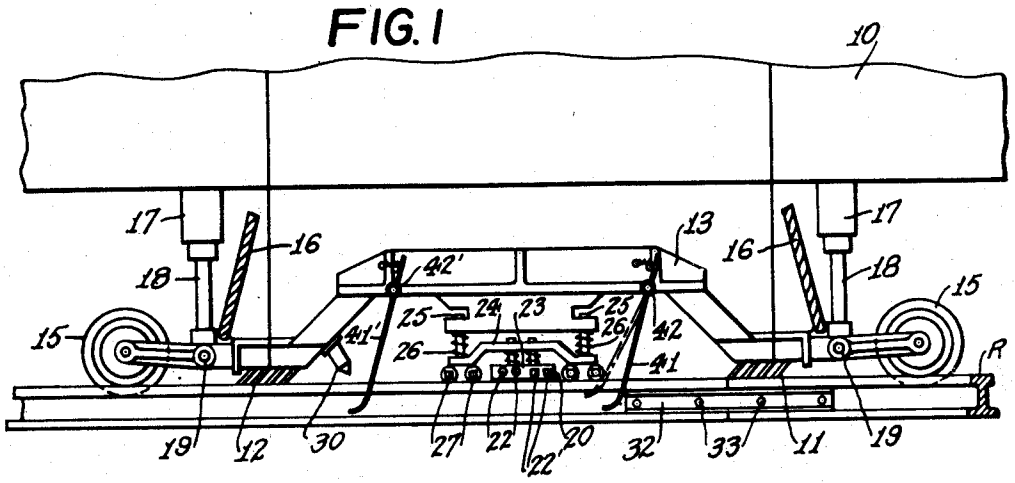
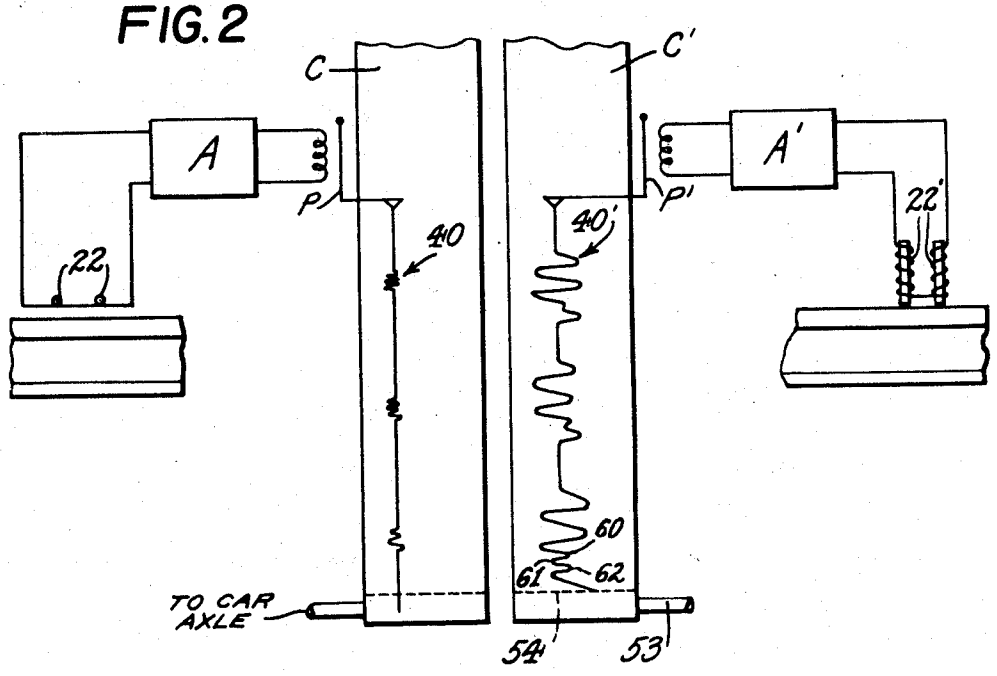


FIG. 2



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FIG. 3

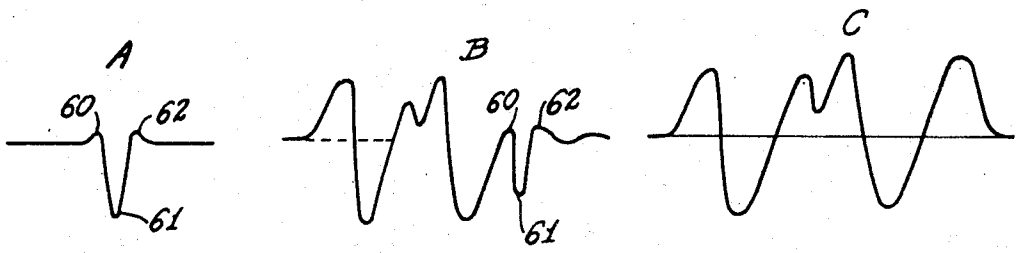
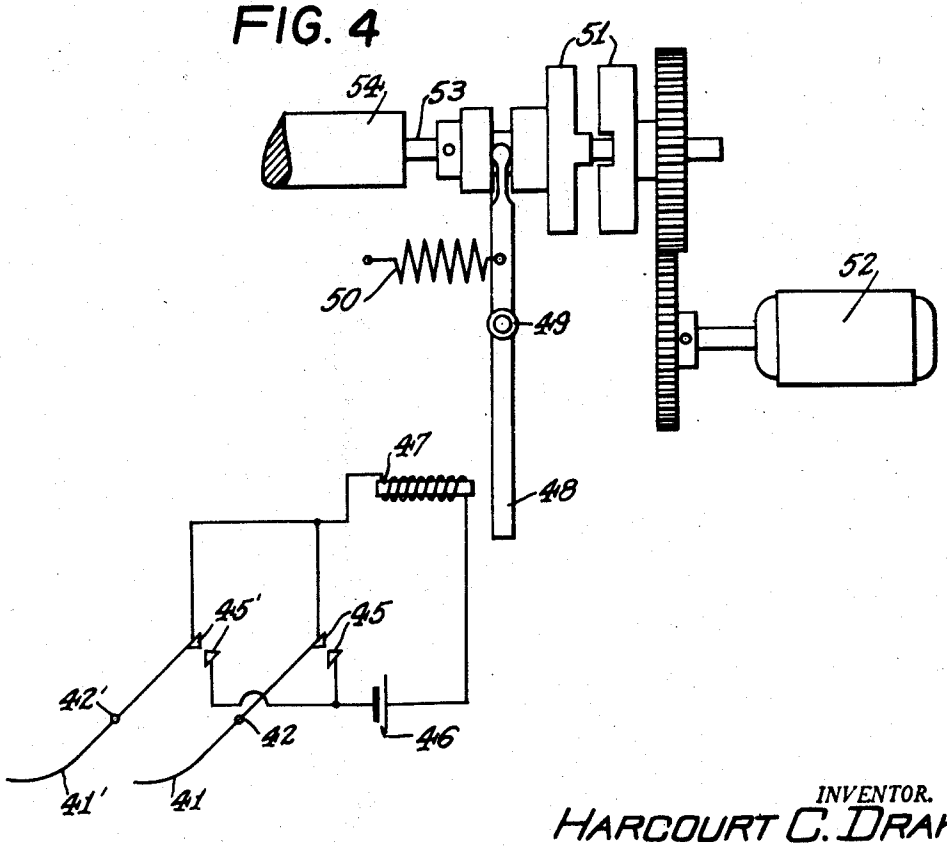


FIG. 4



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RAIL FLAW DETECTOR RECORDING MECHANISM

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6 Claims. (Cl. 346—33)

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This invention relates to rail flaw detector recording 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, 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 a diagrammatic representation illustrating the principle underlying this invention.

Figs. 3A, 3B and 3C are a series of graphs illustrating the type of indications made by joints, with and without a fissure, with the mechanism hereinafter described.

Fig. 4 is a view largely diagrammatic, illustrating the method of driving a recording tape at accelerated speed in response to joints.

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 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.

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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. 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 pen P to record upon the chart C a large number of closely bunched indications as shown at 40. Since the chart is driven from the car axle at the rate of approximately $\frac{1}{8}$" to the foot of travel of the car, and since the angle bar region extends about 2', the bunched indications

40 will extend about ⅛'' 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 resorts to several novel steps. The first of these steps is to provide an additional chart C', together with means for driving this chart at an accelerated speed whenever the detector mechanism is passing over the angle bar region. If it were attempted to drive the chart C' at an accelerated rate continuously, it would be found to be impractical to the point of inoperativeness because when joint indication 40 occurs on chart C the corresponding joint indication 40' on chart C' will quickly pass the operator's field of vision due to the high speed of travel of chart C' and hence the operator will not be able to study the joint indication 40'. It will be understood that whereas chart C operates 1/16'' per foot of track tested, chart C' travels on the order of ¾'' per foot of track tested. However since chart C' is operated only while the detector mechanism is passing over the angle bar region, the chart C' will come to a stop after the angle bar region is passed and will remain stationary until the angle bar region of the next joint is reached. This cessation of movement gives the operator time to inspect the amplified indication 40'.

For actuating the chart C' only in the region of the angle bar, there may be provided a pair of joint fingers 41 and 41' pivoted on the detector carriage at 42 and 42', the fingers 41 being positioned in advance of the detector carriage so as to engage the angle bar just before the detector mechanism reaches the region of flux affected by the angle bar, while the fingers 41' are positioned to the rear of the detector mechanism a distance equal to the distance of flux affected by the angle bar at the leaving end of the bar. The rear finger engages the angle bar before the front finger leaves the bar. When either one or both of the joint fingers are in engagement with the angle bar, a set of contacts 45 or 45' will be closed, and the closure of either set of contacts will close a circuit including battery 46 and a solenoid 47, to energize the solenoid which attracts its armature 48 pivoted at 49, against the action of a spring 50 to close clutch 51. This enables a motor 52 to drive shaft 53 upon which is mounted the driving roller 54 for driving the chart C' at the desired relative high speed. Clutch 51 will be closed when joint finger 41 engages the angle bar and will remain closed until joint finger 41' leaves the angle bar. Therefore chart C' will be driven only during this interval and the operator will have an opportunity to study the joint indications on chart C' in the interval that chart C' is stationary.

Thus by the above-described mechanism there is obtained an amplified, spread-out indication of the angle bar region, which is the first step in my method of indicating defects occurring within this region.

As a second step in my method, I provide as a recording instrument a pen P' which, unlike pen P, is of the type wherein the degree of its movement is a function of the input signal voltage. Such instrument may be a Brush oscillograph which will give a large amplification of movement as well as a movement responsive in degree to the input voltage.

As a third step in my method, I provide a type of detector coil which has the capacity of responding more sensitively to fissures than to irregularities in the electro-magnetic field caused by the angle bar components. For this purpose I provide in addition to coils 22 whose axes are positioned transversely horizontal with respect to the rail, a pair of coils 22' positioned with their axes vertical with respect to the rail. These coils 22' are arranged in tandem and their output may be amplified either by a separate channel in amplifier A or by a separate amplifier A' whose output actuates pen P'.

I have found that coils positioned such as coils 22', when passing over a fissure, produce a characteristic output which causes pen P' to trace the graph shown in Fig. 3A. This characteristic output comprises a short positive peak 60, a large sharp negative peak 61 and a final short positive peak 62. This output in response to a fissure can readily be distinguished from the output in response to the angle bar components. Thus Fig. 3C shows the characteristic output from an angle bar. The graph Fig. 3B shows how the fissure indication 60, 61, 62 superimposed on the graph 3C can readily be distinguished from the indications of the angle bar components.

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, 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 also to variations in said flux caused by the joints, a chart, means for moving the chart relatively slowly in predetermined ratio to the movement of the car, a pen cooperating with the chart, and means whereby said responsive means actuates said pen, the improvement which consists in a second chart, normally ineffective means for moving said second chart at a relatively rapid rate, means actuated only for the interval that said responsive means is passing through the region of flux affected by the joint, means whereby said last-named means when actuated renders said second chart-moving means effective, a second pen cooperating with the second chart, and means for actuating the second pen in response to variations in said flux, said charts being arranged in comparative relation.

2. In a rail flaw detector car adapted to travel over rails connected by joints, 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 also to variations in said flux caused by the joints, a chart, means for moving the chart relatively slowly in predetermined ratio to the movement of the car, a pen cooperating with the chart, and means whereby said responsive means actuates said pen, the improvement which consists in a second chart, normally ineffective means for moving said second chart at a relatively rapid rate, means actuated only for the interval that said responsive means is passing through the region of flux affected by the joint, means whereby said last-named means when actuated renders said second chart-moving means effective, a second pen cooperating with the second chart, and means for actuating the second pen in response to variations in said flux, said last-named means in-

cluding means for actuating said second pen through a distance which is a function of the degree of variation in said flux.

3. In a rail flaw detector car adapted to travel over rails connected by joints, 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 also to variations in said flux caused by the joints, a chart, means for moving the chart relatively slowly in predetermined ratio to the movement of the car, a pen cooperating with the chart, and means whereby said responsive means actuates said pen, the improvement which consists in a second chart, normally ineffective means for moving said second chart at a relatively rapid rate, means actuated only for the interval that said responsive means is passing through the region of flux affected by the joint, means whereby said last-named means when actuated renders said second chart-moving means effective, a second pen cooperating with the second chart, and means for actuating the second pen in response to variations in said flux, said last-named means including a coil positioned with its axis vertical with respect to the rail head.

4. In a rail flaw detector car adapted to travel over rails connected by joints, 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 also to variations in said flux caused by the joints, a chart, means for moving the chart relatively slowly in predetermined ratio to the movement of the car, a pen cooperating with the chart, and means whereby said responsive means actuates said pen, the improvement which consists in a second chart, normally ineffective means for moving said second chart at a relatively rapid rate, means actuated only for the interval that said responsive means is passing through the region of flux affected by the joint, means whereby said last-named means when actuated renders said second chart-moving means effective, a second pen cooperating with the second chart, and means for actuating the second pen in response to variations in said flux, said last-named means including a pair of coils positioned with their axes vertical with respect to the rail head.

5. In a rail flaw detector car adapted to travel over rails connected by joints, 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 also to variations in said flux caused by the joints, a chart, means for moving the chart relatively slowly in predetermined ratio to the movement of the car, a pen cooperating with the chart, and means whereby said responsive means actuates said pen, the improvement which consists in a second chart, normally ineffective means for moving said second chart at a relatively rapid rate, means actuated only for the interval that said responsive means is passing through the region of flux affected by the joint, means whereby said last-named means when actuated renders said second chart-moving means effective, a second pen cooperating with the second chart, and means for actuating the second pen in response to variations in said flux, said last-named means including a pair of coils closely positioned in tandem lengthwise of the rail and with their axes vertical with respect to the rail head.

6. In a rail flaw detector car adapted to travel over rails connected by joints, 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 also to variations in said flux caused by the region of a joint, a normally stationary chart, a pen cooperating with the chart, means responsive only to the region of a joint, and means actuated by said last-named joint responsive means while responding to a joint for moving said chart.

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