Jan. 15, 1952 F. H. KEATON ET AL 2,582,440

RAIL FLAW DETECTION APPARATUS

Filed Sept. 24, 1948 3 Sheets-Sheet 1

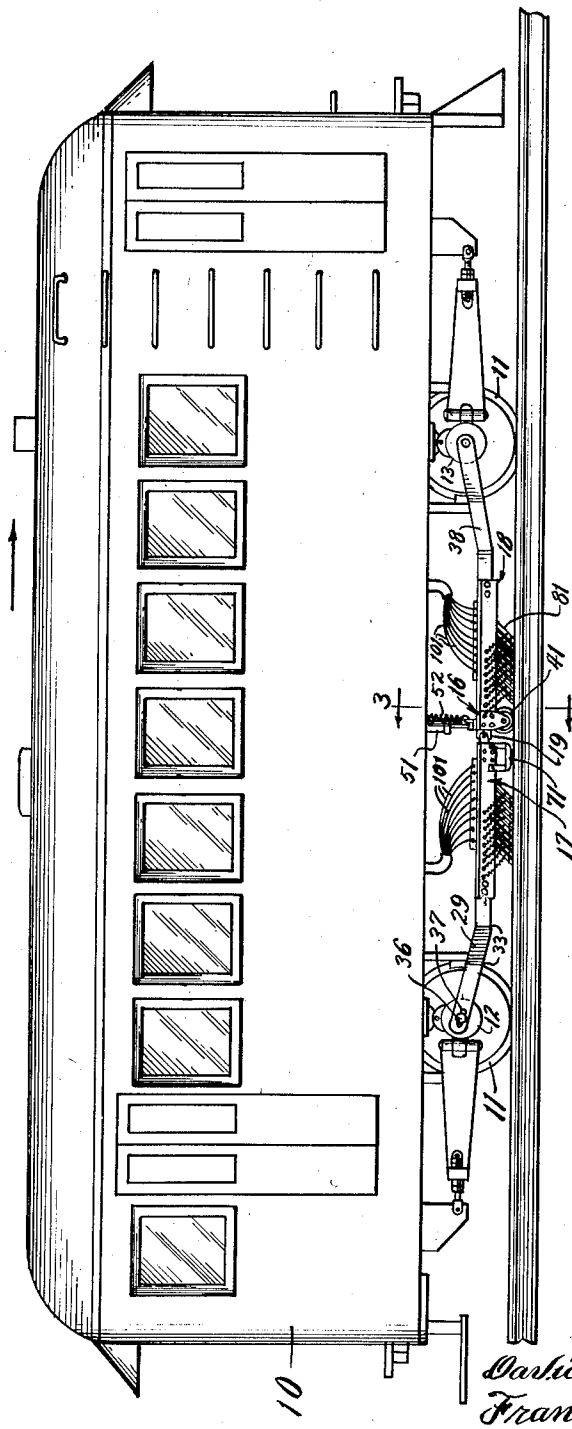


Fig. 1

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Fig-2

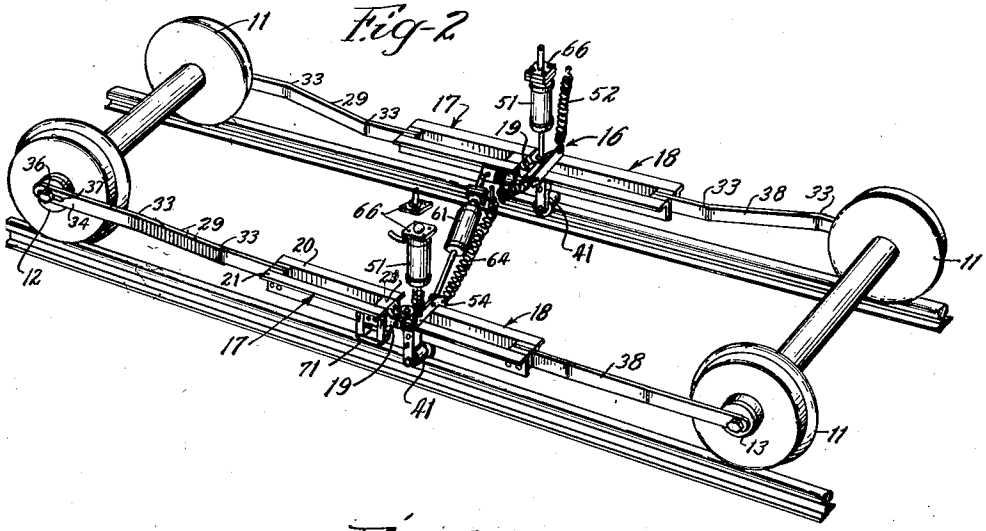


Fig-3

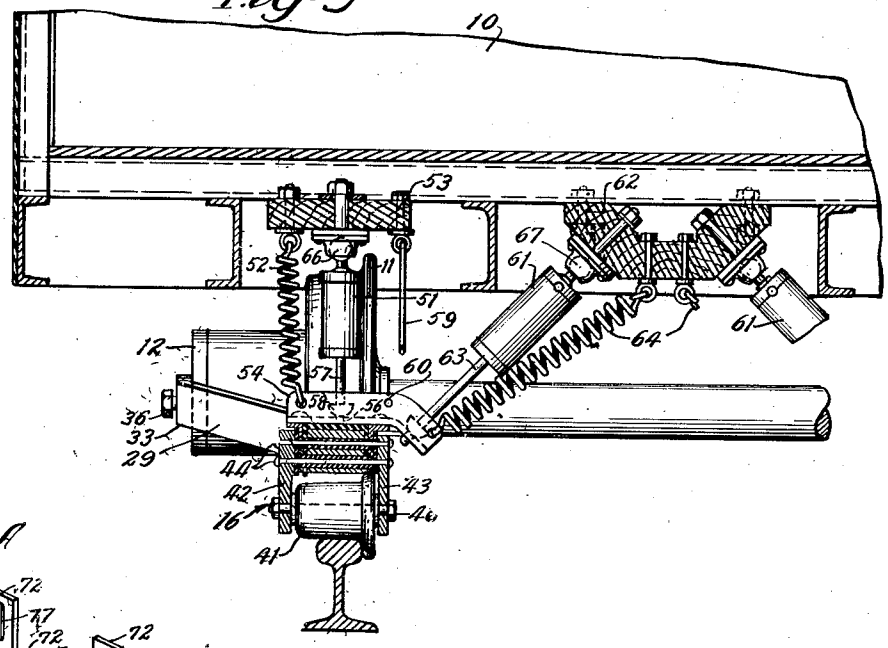
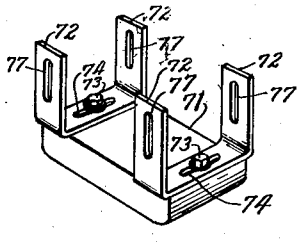


Fig-4



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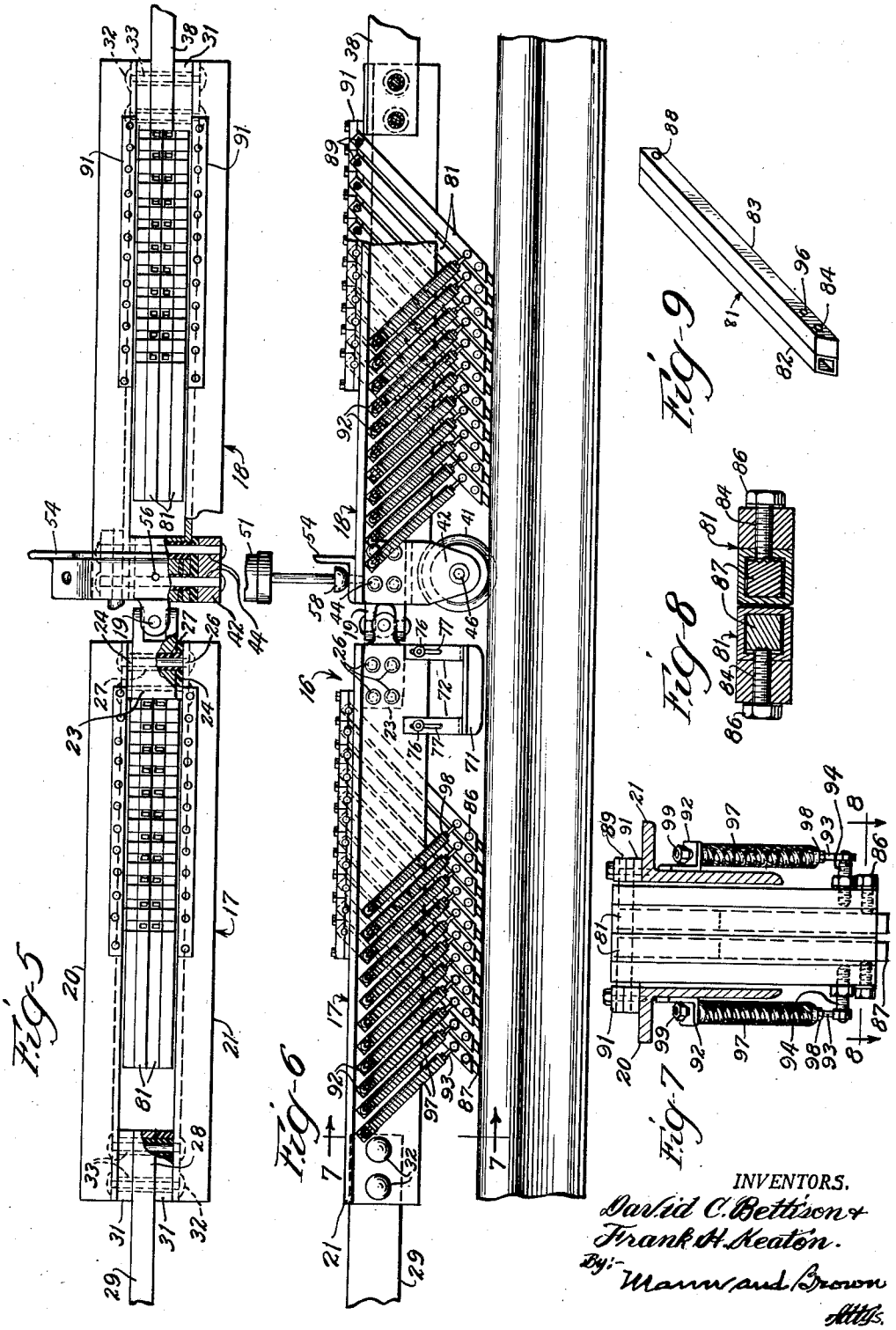


Fig-5

Fig-6

Fig-7

Fig-8

Fig-9

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UNITED STATES PATENT OFFICE

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RAIL FLAW DETECTION APPARATUS

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Application September 24, 1948, Serial No. 50,962

15 Claims. (Cl. 175—183)

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Our invention relates to a carriage for introducing high amperage, low voltage current into a rail for the purpose of flaw detection, the carriage also being used to support the inductive pickup that searches the magnetic field above the rail for non-uniformities in field strength, such non-uniformities generally being indicative of discontinuities in the rail.

In electro-inductive rail flaw detection a pickup is used to measure the strength of the magnetic field about the rail, the upper surface thereof normally being the portion traversed by the pickup. Since the strength of the surrounding field may vary about the different portions of the rail and will vary at different distances from the same surface of the rail, it is highly important that the pickup be maintained a constant distance from the rail and that a substantially constant alignment of the pickup with respect to the rail be kept during the detection process.

In view of the fact that it is necessary in the electro-inductive system of testing to search the rail with the pickup between the electrical brushes that make contact with the rail, it is generally the practice to mount both the brushes and the pickup on a unitary mount or carriage. One advantage of this is that it facilitates raising these elements off the rail when they are not in use and again re-positioning them on the rail when further testing is to be performed. However, the mounting of both the brushes and the pickup on a single carriage introduces some complications, for not only must the pickup maintain a constant orientation and spacing with respect to the rail, but the brushes, spaced out to either side of the pickup, must remain in contact with the top surface of the rail and exert sufficient pressure against that surface to insure the making of a good electrical connection.

Some of the factors which create difficulties with conventional type carriages or with supporting frames carried by the vehicle may be briefly enumerated.

1. Constant orientation and alignment with respect to the rail must be maintained not only when traversing straight track but also along curves of varying radii. On curves such mountings will not conform to the arc of the rail curve but rather will be aligned with a chord of that arc, thereby moving the pickup laterally away from the longitudinal axis of the rail.

2. Variations in the level of the rail between the supports for the mounting will result in varying the spacing of the pickup to the rail.

A principal object of the present invention is

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to overcome the foregoing problems and to provide a mounting in which the pickup and brushes will maintain a substantially constant orientation with respect to the rail and in which the pickup will be maintained a substantially constant distance above the upper surface of the rail.

Additional objects and advantages include: a mounting which is easily raised from, or lowered to, operative engagement with the rail; a mounting requiring little or no maintenance over extended periods of time; a spring biasing for the brush holder, which is readily accessible for adjustment of the pressure with which the brush bears against the rail; a brush holder which will hold a long brush thereby reducing the frequency with which the brushes must be replaced, and in turn reducing the loss from the discard of unusable brush stubs; and, a brush holder in which the brush clamps are located in a position easily reached to replace the brushes or to increase the exposed length of the brush.

Additional objects and advantages will be apparent from the following description read in conjunction with the drawings, in which

Fig. 1 is a side elevation of a rail detector car;

Fig. 2 is a perspective view of the carriage frame upon which the electrical contact brushes and pickup are mounted and showing the means for moving the carriage to and from the working position;

Fig. 3 is a section taken at line 3—3 of Fig. 1;

Fig. 4 is a perspective view of a pickup with the mounting brackets therefor;

Fig. 5 is a plan view of the carriage;

Fig. 6 is a side elevation of the carriage;

Fig. 7 is a section taken at line 7—7 of Fig. 6;

Fig. 8 is a section taken at line 8—8 of Fig. 7; and

Fig. 9 is a perspective view of a brush holder;

In the detection of flaws in rail a car 10, such as shown in Fig. 1, is used to transport the detection apparatus, personnel and related equipment along the track with the detection process taking place en route. In the electro-inductive system of testing, the car will house the generator for providing the necessary current to energize the rail, the recording mechanism, under the supervision of one or more operators, to indicate the presence of non-uniformities in the magnetic field about the rail, and the necessary equipment to provide the propulsive force for moving the car along the track. The car is borne on flanged wheels 11, the axles of which are rotatably engaged in journal boxes 12 and 13. The car is

supported through suitable springs from the journal boxes.

Carriage

The brush carriage, indicated generally by 16, consists of two frame members 17 and 18 positioned end to end substantially over the rail with the adjacent ends of the members connected by means of a universal joint 19. Frame member 17 is formed of a pair of spaced angle irons 20 and 21. At the end of member 17 adjacent member 18 (referred to for convenience as the "adjacent" end) the angle irons are spaced by means of end 23 of universal joint 19 and insulator blocks 24 mounted between end 23 of the universal joint and angle irons 20 and 21. Bolts or rivets 26 serve to assemble the angle irons, insulator blocks, and end of the universal joint. Insulated sleeves 27 about the bolts or rivets 26, in conjunction with insulator blocks 24, prevent electrical contact from being made between the frame member 17 and the universal joint 19.

At the non-adjacent end of frame member 17 the angle irons are spaced by end 28 of support arm 29 and insulator blocks 31. Rivets 32 hold the angle irons securely assembled and attached to end 28 of support arm 29. Insulating sleeves 33 in conjunction with blocks 31 prevent electrical contact between frame member 17 and support arm 29.

Support arm 29 is bent as indicated at 33 in order that the outer end of the arm 34 will extend outwardly of the journal box 12. Bolt 36, passing through longitudinal slot 37 in arm 29, supports the arm from journal box 12. The slot, coupled with the fact that the arm 29 is loosely supported between the head of bolt 36 and journal box 12, allows both pivotal and longitudinal movements of the carriage with respect to the journal box 12, which movements are necessary to permit carriage 16 to be raised and lowered as hereinafter described.

The construction of frame member 18 and its mounting by means of support arm 38 is substantialy identical with the foregoing description of frame member 17 and support arm 29 except that no provision is made for longitudinal movement of arm 38 with respect to journal box 13. The normal direction of car movement during testing operations is indicated in Fig. 1, and it will be seen that journal 13 will be at the leading end of the car. At the leading end of the carriage it is desirable to only allow pivotal movement of the carriage with respect to the car, and thus no slot is provided in arm 38.

The articulated (adjacent) ends of frame members 17 and 18 are supported in constant alignment with the rail by means of flanged wheel 41 connected to frame member 18 through plates 42 and 43. Plates 42 and 43 are attached to member 18 by means of rivets 44 which correspond to rivets 26 on frame member 17. Bolt 46, interconnecting plates 42 and 43, forms an axle for wheel 41. Insulating blocks and sleeves prevent an electrical connection between frame member 18, universal joint 19 and/or wheel 41.

Positioning mechanism

In many instances a detector car must be moved from point to point without the necessity of performing flaw detection en route. In such cases it is highly desirable to move the electrical contact brushes out of engagement with the rail to prevent undue wear on the brushes. To perform this function we have provided a fluid-operated piston mechanism 51 and a spring 52 to lower and raise, respectively, the carriage 16 (see Figs. 2 and 3). The upper end of the piston mechanism 51 and spring 52 are secured to the frame of the car 10 through insulating block 53, the purpose of the block being to prevent electrical contact between car 10 and carriage 16. Bracket 54, affixed to carriage frame member 18, is provided with an opening 56 into which is received the end of piston rod 57 of piston mechanism 51. Opening 56 is somewhat larger in diameter than the end of piston rod 57 to permit angular movement of the piston rod with respect to bracket 54. Semi-spherical-shaped member 58, affixed to piston rod 57, seats against the upper face of bracket 54 so that as fluid pressure is applied to the piston, and the piston rod is extended, carriage 16 will be pushed downwardly towards the rail. As the fluid pressure is relieved, spring 52, which has been extended by the prior movement of the piston, will contract to raise the carriage away from the rail.

Obviously it would be possible to use a piston to raise the carriage and a spring to lower it or to use a double-acting piston mechanism to both raise and lower the carriage. These other forms would have the disadvantage that any failure of fluid pressure on the piston would result in permitting the carriage to become lowered. In the form shown, if there is a failure of fluid pressure, the spring will retract to raise the carriage and prevent any possible injury that might result from inordinate lowering of the carriage.

When the car is traveling without testing being performed en route, it may be desirable to suspend the carriage from a hook 59, the end of which is slipped through opening 60 in bracket 54, to prevent bouncing of the carriage.

Piston mechanism 61 serves to push the carriage outwardly to bring the flange of wheel 41 into engagement with the side of the rail and to hold it there during the testing procedure so that the articulated portion of the carriage will maintain a definite orientation with respect to the rail. The upper portion of piston assembly 61 is supported from car 10 through insulating bracket 62, and the piston rod 63 of the assembly is aligned with and bears against bracket 54 in the same manner as previously described for piston assembly 51 and piston rod 57. Spring 64, connected at one end to insulating bracket 62 and at the other end to carriage bracket 54, is extended by the outward movement of piston rod 63. When the fluid pressure on piston mechanism 61 is relieved, the spring will bring the carriage 16 inwardly away from its position above the rail. Ball joint 66 at the upper end of piston assembly 51 allows that assembly to swing to facilitate the inward movement of the carriage 16. Similarly, a ball joint 67 at the upper end of piston assembly 61 allows that assembly to follow the upward and downward movements of the carriage.

The procedure in lowering the carriage is to first apply fluid pressure to piston assembly 51 to bring wheel 41 down against the top of the rail. The carriage 16 will at this point be swung somewhat inwardly by the action of spring 64, although this displacement is not very large and the length of wheel 41 is sufficient to assure that the wheel will come into contact with the top of the rail. After the wheel has come to rest against the top of the rail, fluid pressure is applied to piston assembly 61, moving the carriage outwardly and bringing the flange of the

wheel into engagement with the side of the rail. Fluid pressure is left on these two piston assemblies during the testing operation, thus keeping the wheel firmly against the top of the rail with the flange of the wheel pressed against the side of the rail. Thus, the adjacent ends of members 17 and 18 will be maintained at a constant elevation over the rail and in constant alignments with respect to the rail.

Pickup mounting

The pickup and mouting therefor is best illustrated in Figs. 4 and 6. The pickup 71 has a bracket 72 affixed to either end thereof by means of bolts 73. The bolts 73 project through slots 74 in brackets 72 and are threaded into the body of the pickup 71. Bolts 76 extend through slots 77 in bracket 72 to fasten the pickup to the adjacent end of frame member 17. By loosening bolts 76 the brackets may be slid upwardly or downwardly, through the range of adjustment allowed by slot 77, to raise or lower the pickup with respect to the surface of the rail. The pickup may be moved laterally with respect to the rail by loosening bolts 73 and sliding them sidewardly in slot 74. After these adjustments have been made to properly position the pickup with respect to the rail, the bolts may be retightened; and because of the constant orientation and spacing features previously described, the pickup will maintain the set position with respect to the rail throughout the testing run.

Brush mountings

Each brush holder 81 consists of a rectangular tube 82 joined to a bar 83. At the lower end the bar and tube are threaded, as shown at 84, to receive a set screw 86 used to lock the brush 87 in place in tube 82. The brush holders are mounted in pairs between angle irons 20 and 21, with the tubular portions 82 of each pair adjacent to each other, as shown in Fig. 7. At the upper end of the holder an opening 88 is adapted to receive a pivotal shaft 89, which shaft extends beyond the ends of a pair of brush holders and is supported in pillow blocks 91 attached to the top of the angle irons of the frame members.

An angular clip 92 is attached to either side of the angle irons 20 and 21 by counter-sunk rivets, and the outer leg of the clip is provided with an opening to receive bolt 93, the opening being larger than the diameter of the bolt to allow the bolt to move freely with respect to the clip. The lower end of the bolt is attached to brush holder 81 by means of a stud 94 threaded into opening 96 in the brush holder. The lower end of bolt 93 is formed with an annular ring which fits over the outer end of the stud and is secured thereto by a cotter key (not shown).

A coiled compression spring 97 about bolt 93 provides pressure to hold the brush in contact with the rail. The upper end of the spring bears against the under-face of clip 92, and the lower end of the spring bears against a nut 98 threaded onto bolt 93. The nut may be moved up or down to adjust the compression of the spring.

At the upper end of bolt 93 above clip 92 is a nut 99 which, when the carriage is lowered into engagement with the rail, will be spaced somewhat from the upper face of clip 92 due to compression of spring 97 by the pressure of brush 87 against the rail. The purpose of nut 99 is to allow only a limited extension of spring 97, and consequently the brush holder, as the carriage is raised and the brush is no longer bearing against the rail.

Pigtails 101 are connected to the source of electrical energy within the car and to the brush holders externally of the car. The pigtails may be attached to the upper end of bar 83 of the brush holder 81 through a connecting screw, or by welding. Bar 83 is preferably made of a copper base alloy and provides a low resistance path for the electrical current to the brush, the resistance being sufficiently low that variations in the length of the brush within tube 82 will not cause any appreciable change in the voltage drop between the source of electrical current and the end of the brush.

Operation

From the foregoing description it will be appreciated that a carriage has been devised which is not only easily applied to a detector car designed for it, but also may be used in the conversion of existing detector cars. It may be made to fit almost any size of existing car merely by changing the lengths of support arms 29 and 38 and may be readily hung from the existing journal boxes by the addition of bolts 36. The only other necessary structural connection to the car is that provided through brackets 53 and 62, which may be easily mounted without involving any fundamental changes in the existing car.

Initial adjustments include: pre-setting the position spring pressure used to hold the brush against the rail, which is done by means of nut 98; setting nut 99 sufficiently above clip 92 to allow for some wear of the brush before the brush must be re-set and yet sufficiently close to clip 92 that the brush will be well above the upper surface of the rail when the carriage is moved into raised position; and positioning pickup 71 in the desired alignment and distance to the rail.

Before starting each day's testing run, or oftener if necessary, the operator of the car should examine each brush mounting to observe the spacing between nut 99 and clip 92. If the space is not adequate to allow for the wear of the brush until the next inspection period, set screw 86 may be loosened and the brush may be extended a greater distance from the holder, whereupon the set screw is again tightened. Due to the positioning of the set screw at the bottom end of the brush holder, it is a very simple matter to make this correction with the carriage suspended in the raised position. The particular mounting of the brush holder from the carriage permits tube 82, in which the brush is held, to be made much longer than has been possible with prior devices. A longer brush holder allows the use of correspondingly longer brushes with an increase in the wear of an individual brush and with a decrease in the loss occasioned by the discard of unusable brush stubs.

After the length of the brushes has been correctly adjusted, fluid pressure is applied to piston mechanism 51 to lower the carriage and to piston mechanism 61 to move the carriage outwardly, with the flange of guide wheel 41 in contact with the inner face on the rail. Wheel 41, being held securely in contact with the upper and side faces of the rail, will assure that the adjacent ends of frame members 17 and 18 are maintained at substantially constant distances above the upper face of the rail and in substan-

tially constant alignments with respect to the longitudinal axis of the rail.

The pickup, being supported from the adjacent end of frame member 17, will be held in the pre-set alignment and spacing from the rail. The use of the detector car on straight track or curved track of varying radii will cause no substantial change in the positioning of the pickup, nor will low spots in the track vary to an appreciable extent the spacing of the pickup to the rail.

The brushes, being spaced only a short distance to either side of the universal joint, will reflect only to a very limited extent the movements that may occur in the outer ends of support arms 29 and 38. The brushes will at all times maintain a substantial face contact with the upper surface of the rail and insure a good electrical connection thereto.

It should be understood that the particular embodiments of the invention shown in the drawings and described herein are for the purpose of complying with Section 4888 of the revised statutes and should not be construed as imposing limitations on the appended claims except as may be required by the prior art.

We claim:

1. In a rail flaw detection vehicle, a car, a carriage mounted on the car, and adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, and means engaging the rail for supporting the adjacent ends of said members a substantially constant distance from the rail.

2. In a rail flaw detection vehicle, a car, a carriage mounted on the car, and adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, and means engaging the rail for maintaining the adjacent ends of said members in substantially constant planes of orientation with respect to the rail.

3. In a rail flaw detection vehicle, a car, a carriage mounted on the car, and adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, and means engaging the rail for supporting the adjacent ends of said members a substantially constant distance from the rail and in substantially constant planes of orientation with respect to the rail.

4. In a rail flaw detection vehicle supported on wheels mounted in journal boxes, a car, a carriage mounted on the car, and adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, means connecting the non-adjacent ends of the members to the journal boxes to support the non-adjacent ends from said journal boxes, and means engaging the rail for supporting the adjacent ends of said members a substantially constant distance from the rail.

5. In a rail flaw detection vehicle, a car, a carriage mounted on the car, and adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting

the adjacent ends of the members, means engaging the rail for supporting each end of said members substantially constant distances from the rail and in substantially constant planes of orientation with respect to the rail, brush holders supported from each of said members, and means for electrically insulating the brush holder on one of said members from the rail, except through the brush contact, and from the brush holder on the other member.

6. In a rail flaw detection vehicle, a carriage adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, means to pivotally support the non-adjacent ends of the members from said vehicle, a pickup holder on said carriage adjacent said joint, and means connected to said carriage adjacent said joint to support the holder a substantially constant distance from the rail and in a substantially constant plane of orientation with respect to the rail.

7. In a rail flaw detection vehicle, a carriage adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, means to pivotally support the non-adjacent ends of the members from said vehicle, a pickup holder on said adjacent ends of one of the members, a rail engaging wheel connected to said adjacent end of the other of the members whereby the pickup holder will be supported a substantially constant distance from the rail and in a substantially constant plane of orientation with respect to the rail.

8. In a rail flaw detection vehicle, a carriage adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, means to pivotally support the non-adjacent ends of the members from the vehicle, a pickup holder on said carriage adjacent said joint, a rail engaging wheel connected to said carriage adjacent the joint to support the adjacent ends of the members at substantially constant distances from the rail and in substantially constant planes of orientation with respect to the rail, brush holders supported from each of said members and spaced from the joint, and means for electrically insulating the brush holder on one of said members from the brush holder on the other of the members except through brush contacts with the rail.

9. In a rail flaw detection vehicle, a carriage adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, means pivotally supporting the non-adjacent ends of the carriage from the vehicle, means adjacent the joint to support the adjacent ends of the members at substantially constant distances from the rail and in substantially constant planes of orientation with respect to the rail, and means including a fluid-operated piston to selectively raise or lower the adjacent ends of the members with respect to the rail.

10. In a rail flaw detection vehicle, a carriage adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, means pivotally supporting the non-adja-

cent ends of the carriage from the vehicle, means adjacent the joint to support the adjacent ends of the members at substantially constant distances from the rail and in substantially constant planes of orientation with respect to the rail, and means including a pair of fluid-operated pistons to selectively raise or lower the adjacent ends of the members and to move said ends transversely with respect to the rail.

11. In a rail flaw detection vehicle, a carriage adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, each of said members including a pair of spaced side plates, a universal joint connecting the adjacent ends of the members, means for supporting each end of said members substantially constant distances from the rail and in substantially constant planes of orientation with respect to the rail, a brush holder between said plates, said brush holder being pivotally connected to said member adjacent the upper end of the holder and projecting downwardly at an angle toward said rail, and resilient means to the outside of one of said plates and connected to the member at one end thereof and to the brush holder at the other end thereof to bias the holder toward the rail.

12. In a vehicle adapted to move in one direction along a rail for the detection of flaws therein, a carriage including two frame members positioned in substantially longitudinal alignment, each of said members including a pair of spaced side plates, a universal joint connecting the adjacent ends of the members, means for supporting each end of said members substantially constant distances from the rail and in substantially constant planes of orientation with respect to the rail, a brush holder between said plates and pivotally connected to said member adjacent the upper end of the holder, said holder projecting toward the rail from the pivot in a direction opposite to that of the movement of the vehicle, and a compression spring outside of one of the plates, the upper end of the compression spring being fixed in relation to the member in a position to the rear, in the direction of vehicle movement, of the pivot, the lower end of the spring being connected to the holder below the pivot point to bias the holder toward the rail.

13. In a vehicle adapted to move in one direction along a rail for the detection of flaws therein, a carriage including two frame members positioned in substantially longitudinal alignment, each of said members including a pair of spaced side plates, a universal joint connecting the adjacent ends of the members, means pivotally supporting the non-adjacent ends of the carriage from the vehicle, means adjacent the joint to support the adjacent ends of the members at substantially constant distances from the rail and in substantially constant planes of orientation with respect to the rail, means including a fluid-operated piston to raise or lower the adjacent ends of the members with respect to the rail, a brush holder between said plates and pivotally connected to said member adjacent the upper end of the holder, said holder projecting toward the rail from the pivot in a direction opposite to that of the movement of the vehicle, a compression spring outside of one of the plates, the upper end of the compression spring being fixed in relation to the member in a position to the rear, in the direction of vehicle movement, of the pivot, the lower end of the spring being connected to the holder below the pivot point to bias the holder toward the rail, and means to limit the extension movement of said spring.

14. In a rail flaw detection vehicle, a car, a carriage mounted on the car, and adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, a flanged wheel rotatably connected to the carriage adjacent the joint, and means to hold the flange of the wheel in engagement with a side of the rail.

15. In a rail flaw detection vehicle, a car, a carriage mounted on the car, and adapted to be moved along a rail, said carriage including two frame members positioned in substantially longitudinal alignment, a universal joint connecting the adjacent ends of the members, a flanged wheel rotatably connected to one of said members adjacent the joint, means to hold the flange of the wheel in engagement with a side of the rail, a pickup holder connected to the other of the members adjacent the joint, and a pair of brush holders, one of said brush holders being supported by said one member and the other of the brush holders being supported by said other member, said holders projecting downwardly toward the rail to either side of the pickup holder and wheel.

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