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[54] **WEIGHING DEVICE**
10 Claims, 11 Drawing Figs.

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 177/208, 177/211

[51] Int. Cl. **G01g 3 12,**
G01g 19/04

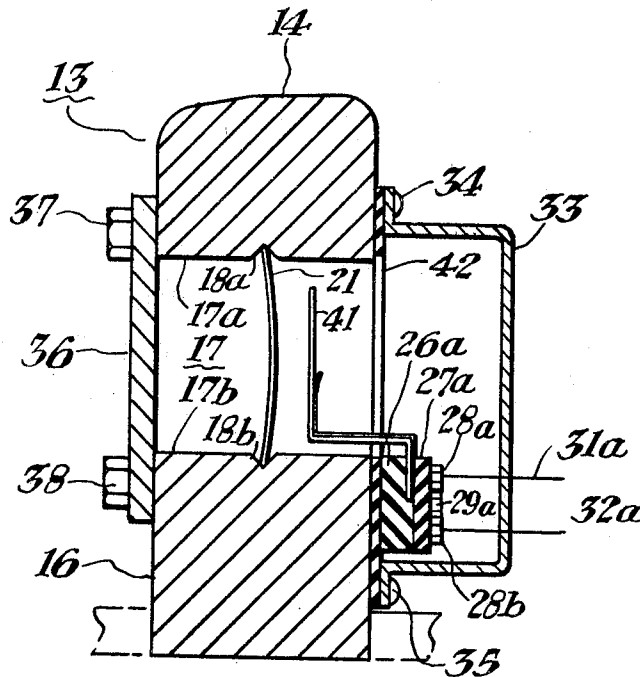
[50] Field of Search 177/163,
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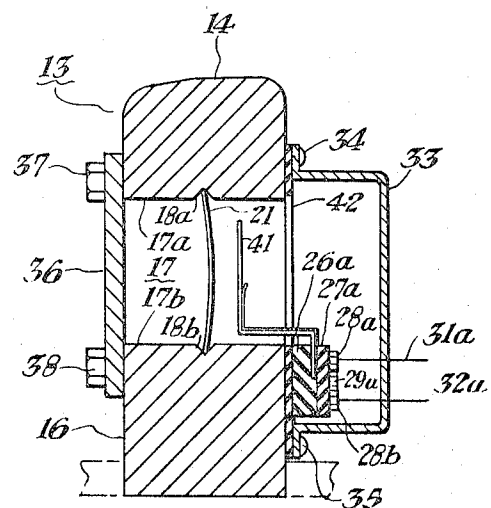
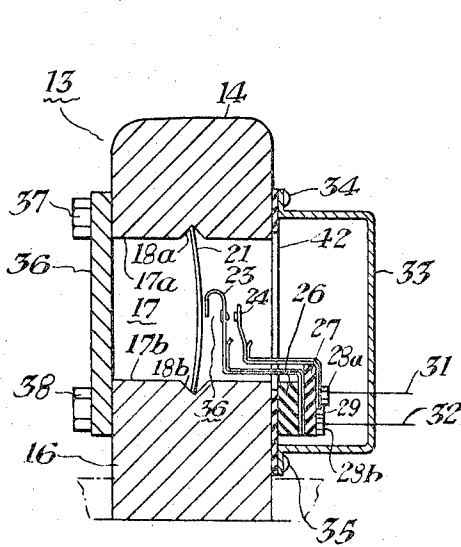
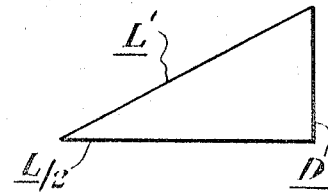
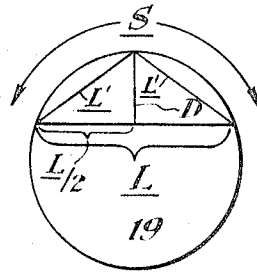
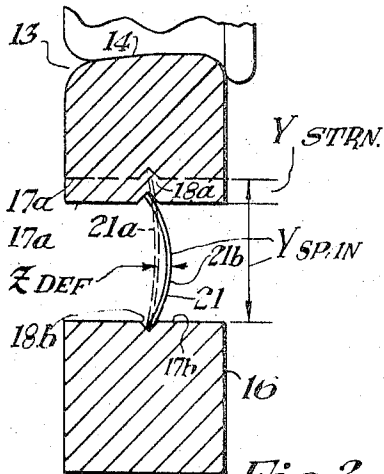
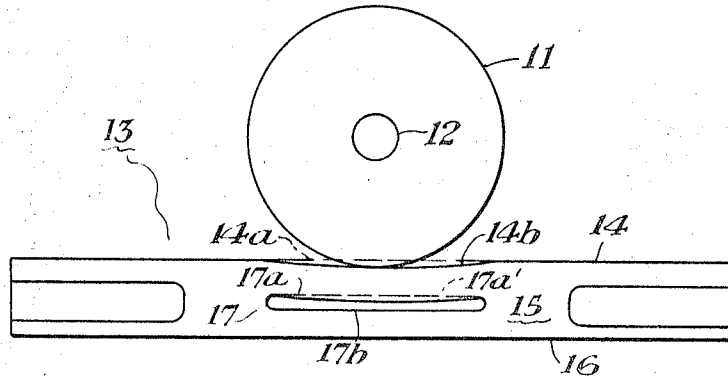
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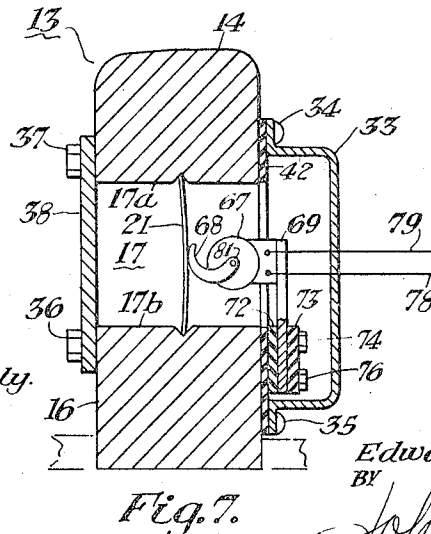
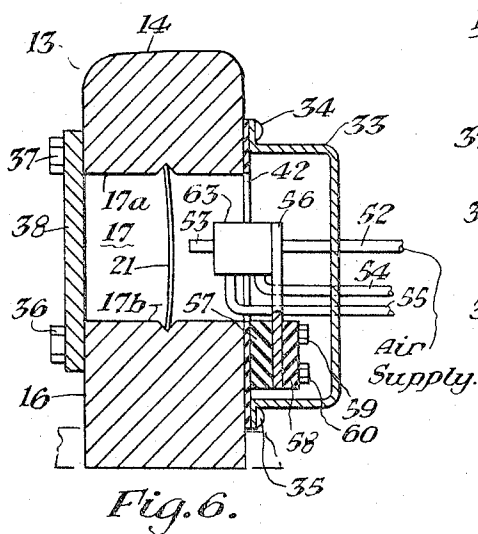
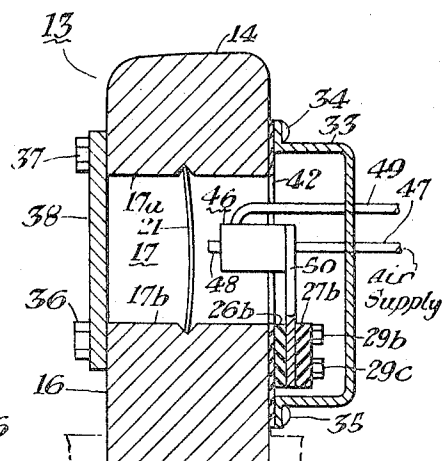
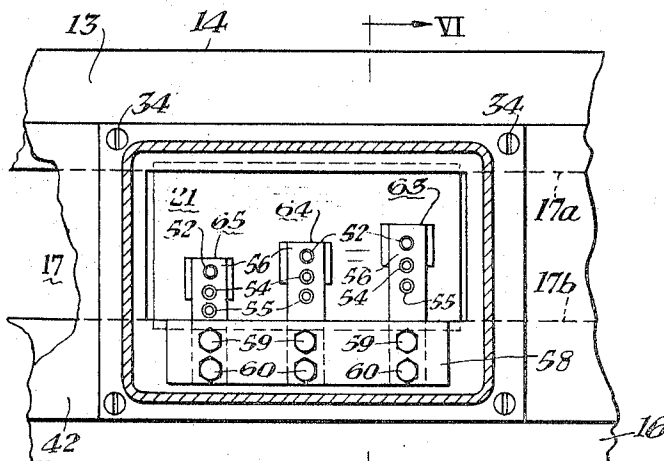
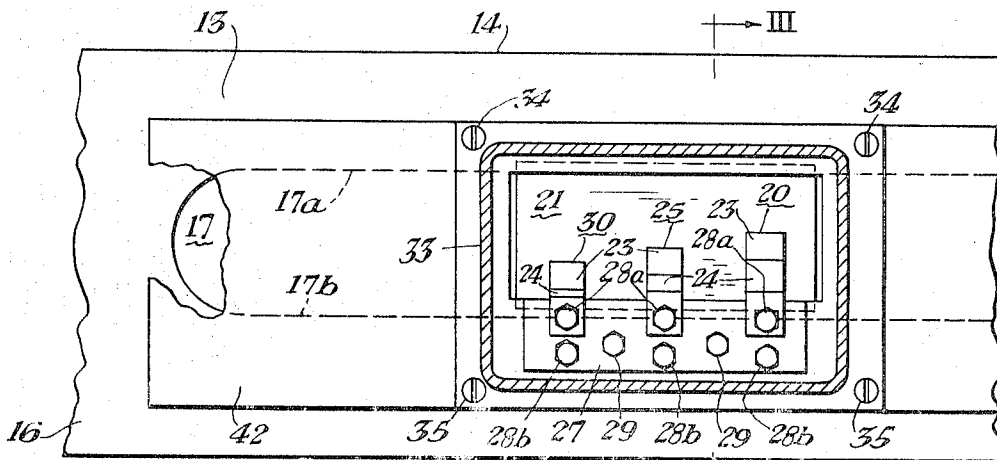
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ABSTRACT: This invention relates to a weigh rail having a crown, a web, a flange portion and an elongated slot extending transversely through the web portion between the crown and flange portions. A resiliently deformable means is interposed between the upper and lower surfaces of the slot such that deflection of the crown portion produces an orthogonal deflection of the resiliently deformable means with respect to the deflection of the crown portion. A transducing means is cooperatively associated with the resiliently deformable means and is responsive to a deflection in the resiliently deformable means for providing an indication which is directly proportional to the amount of deflection of the crown portion.





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WEIGHING DEVICE

My invention relates to a weight rail.

More specifically, my invention relates to a weight rail having a crown, a web, a flange portion and a slot formed between the crown and flange portions. The slot extends transversely through the web portion and has a relatively long dimension disposed longitudinally along the rail. A resiliently deformable means is interposed between the upper and lower surfaces of the slot. This resiliently deformable means is deflected in conjunction with a deflection of the crown portion of the rail. The resiliently deformable means is deflected orthogonal to the direction of motion of the deflection of the crown portion by a passing railway vehicle. A transducing means is cooperatively associated with the resiliently deformable means and is responsive to the orthogonal deflection of the resiliently deformable means for providing an indication which is directly proportional to the amount of the deflection of the crown portion of the rail, and, in turn, the weight of the passing railway vehicle.

In the past, weight rails for measuring the weights of railway vehicles employed various lever arrangements, such as, those shown in U.S. Pat. Nos. 2,902,595 and 2,487,613 for transducing or converting rail deflection into an effective indication of vehicle weight. It will be noted that these previous arrangements include a primary as well as a secondary lever each of which is pivotally moved in response to the deflection of the weight rail. The pivotal movement of the secondary lever is employed to control a transducing means. It will be further noted that the primary lever is interposed within a slot longitudinally displaced along the rail, and is arranged to have one end mechanically contact the down portion of the rail. This primary lever is pivoted about a suitable bearing or fulcrum point which is rigidly fixed to provide rotational movement and to prevent translational movement. The other end of the primary lever is arranged to cooperate with an adjustment screw carried by one end of the secondary lever. The secondary lever is also pivoted on a suitable bearing or fulcrum point similar to the primary lever fulcrum point. The opposite end of the secondary lever is cooperatively associative with appropriate transducing means such as a bank of movable and stationary contacts. Accordingly, any downward deflection in the crown portion of the weigh rail causes a corresponding downward movement of the one end of the primary lever. This causes the opposite end of the primary lever, and, in turn, the adjustable end of the secondary lever to move upwardly. This upward movement causes the other end of the secondary lever to move downwardly. The bank of contacts are arranged such that they are successively closed in weight responsive sequential order depending upon the weight of a railway vehicle on the weigh rail. That is, a lightweight vehicle will only result in the closing of a single contact of the bank of contacts transducing means while a mediumweight vehicle will result in the closing of a pair of contacts and so on.

However, there are several disadvantages and certain undesirable features incorporated in the above-noted types of prior art weight rail arrangements which contribute to the need for a more desirable type of weight rail. First, in previous weigh rails, the maximum obtainable ratio between downward movement of the contact operating end of the secondary lever and the downward deflection of the crown portion of the rail itself is in the order of only 10 to 1. It will be appreciated that such a ratio is small so that there is little, if any, latitude in the adjustment of the adjusting screws. Second, the large number of moving parts required in previous weigh rails increases the amount of mechanical wear and results in repeated maintenance and repair problems. Third, the prior art types of weigh rails are also initially relatively expensive. Fourth, since the bank of contacts move in a vertical movement, the vibrational effects upon the operation of the weight rail result in erroneous weight indications. Thus, it will be appreciated that a new and improved weigh rail free of the above-mentioned disadvantages is desirable for more efficient railway operation.

It is therefore an object of this invention to provide a novel weight rail for measuring various degrees of vehicular weight with greater weight sensitivity and lesser adjustment requirements.

Another object of this invention is to provide an improved weigh rail with fewer moving parts so that it is less susceptible to mechanical wear.

Yet another object of this invention is to provide a new and improved weigh rail which is more economic in construction as well as in maintenance.

Still another object of this invention is to provide a novel weigh rail which is less affected by environmental vibrations and other adverse conditions.

Yet still another object of this invention is to provide an improved weigh rail which is compact.

A further object of this invention is to provide a new and improved weigh rail which measures varying degrees of vehicular weight by the employment of a rail having a crown, a web, a flange portion, and a slot longitudinally disposed through the web portion and having a resiliently deformable means interposed between its upper and lower surfaces and a transducing means responsive to the deflection of the resiliently deformable means for indicating the weight of a railway vehicle.

In the attainment of the foregoing objects, the present invention employs a weigh rail for weighing a railway vehicle as it moves through a section of track. The weigh rail includes conventional crown, web, and flange portions and is provided with an elongated slot disposed between the crown and flange portions. The slot extends transversely through the web portion and has a relatively long dimension coincident with the length of the rail. A resiliently deformable means, preferably in the form of a metallic or synthetic plate, is interposed between the upper and lower surfaces in the slot. This resiliently deformable plate is deflected in conjunction with a deflection in the crown portion of the rail caused by a passing railway vehicle. The direction of motion of the deflection of the resiliently deformable plate which is orthogonal to the direction of motion of the deflection of the crown portion of rail is employed to control a transducing means. The transducing means may consist of a bank of contacts, a plurality of digital back pressure switches, an analogue back pressure sensor, a variable capacitive device, or a rheostat. Accordingly, the transducing means is controlled in accordance with the amount of orthogonal movement of the resiliently deformable plate for providing an indication which is proportional to the weight of the vehicle passing over the rail.

Other objects and advantages of the present invention will become apparent from the ensuing description of various illustrative embodiments thereof, in the course of which reference is had to the accompanying drawings in which:

FIG. 1 illustrates a vehicle wheel passing over a rail section which has an elongated slot formed in its web portion.

FIG. 2 depicts a sectional side view of the rail section of FIG. 1 with the above described resiliently deformable plate interposed between the upper and lower surfaces of the slot.

FIGS. 2A and 2B illustrate geometric figures which aid in providing a mathematical description of the lateral deflection of the resiliently deformable plate of FIG. 2.

FIG. 3 illustrates one embodiment of a weigh rail of the present invention wherein the transducing means comprises a plurality or bank of electrical contacts.

FIG. 3A shows a front view, with portions removed, of the embodiment of the weigh rail of the present invention of FIG. 3.

FIG. 4 depicts another embodiment of a weigh rail of the present invention wherein the resiliently deformable means is a dynamic metal plate and the transducing means is a static metal plate.

FIG. 5 illustrates yet another embodiment of a weigh rail of the present invention wherein the transducing means is a fluidic back pressure sensor.

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FIG. 6 depicts still yet another embodiment of a weigh rail of the present invention wherein the transducing means is a plurality of fluidic back pressure switches.

FIG. 6A shows a front view with portions removed of the embodiment of the weigh rail of the present invention of FIG. 6.

FIG. 7 illustrates another embodiment of a weigh rail of the present invention wherein the transducing means is a variable resistance.

A description of the above embodiments will follow and then the novel features of the invention will appear in the appended claims.

Reference is now made to the drawings and, particularly to FIG. 1, which shows a railway vehicle wheel 11 rotatably secured on axle 12 passing over a weigh rail section 13. The weigh rail section 13 consists of a running crown portion 14, a web portion 15, and a supporting flange portion 16 appropriately secured to conventional ties (not shown) in the usual manner. A slot 17 is formed in the weigh rail 13 and extends transversely through the web portion 15. The slot 17 is shown having a relatively long dimension longitudinally along the length of the weigh rail section 13. The elongated slot 17 includes a movable upper surface 17a, and a stationary lower surface 17b. Accordingly, whenever the wheel 11 of a railway vehicle passes over the slot 17, the upper crown portion 14 of rail section 13 will be deflected from a normal position as shown by dotted line 14a to a deformed position as shown by solid line 14b. The amount of deflection of the crown portion 14 of rail section 13 will, of course, vary with the weight of each passing railway vehicle. The deflection of the upper crown portion 14 of rail section 13 will cause a corresponding or proportional amount of deflection to occur in the upper surface 17a of the slot 17, as shown by the solid outline 17a'.

Referring now to FIG. 2 there is depicted a cross-sectional view of the weigh rail 13 of FIG. 1 with a resiliently deformable plate 21 interposed between the upper and lower surfaces 17a and 17b. As shown, the upper and lower extremities or edges of deformable plate 21 are positioned within a pair of milled grooves 18a and 18b, respectively. It is desired that the resiliently deformable plate 21 be initially prestressed and slightly tensed to prevent slipping and dislodgement from the slot 17. Accordingly, when a vehicle wheel passes over the crown portion 14 of rail section 13, the crown portion 14 will flex and in turn cause a proportional amount of deflection in the upper surface 17a of slot 17 to bring the upper surface 17a to a position shown by the solid line 17a' as shown in FIG. 2. Hence, the resiliently deformable plate 21 will move and bend from its original position at "no load" shown by dotted outline 21a to the position shown in solid outline 21b in FIG. 2. For the purpose of discussion, the vertical amount of downward deflection of crown portion 14 of rail section 13 is designated as Y_{STRN} , and the amount of deflection of the center of the resiliently deformable plate 21 is designated as Z_{DEF} . The original height or vertical dimension of the slot at "no load" in which the resiliently deformable plate 21 is positioned is designated as Y_{SPAN} .

In viewing FIGS. 2A and 2B, it will be noted that the geometric figures are employed for illustrating and analyzing the mathematical calculation of the horizontal deflection at the center of resiliently deformable plate 21 of FIG. 2. For example, FIG. 2A shows a circular diagram 19 having a chord L subtending an arc of length S two lines of length L' extending from the end points of chord L to the midpoint of arc S . Thus, an isosceles triangle is formed by sides L' and chord L which has a height D . The arc S is analogous to the resiliently deformable plate 21 in its deflected position. It will be appreciated that since the height of the resiliently deformable plate 21 at "no load" is approximately equal to the height of the slot 17 at "no load," then $S=Y_{SPAN}$. The chord L is analogous to the difference between the height of the slot 17 at "no load," Y_{SPAN} , and the amount of downward vertical deflection of the upper surface 17a of the slot 17 between an unloaded and loaded weigh rail of FIG. 2, Y_{STRN} .

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More simply, $L=Y_{SPAN}-Y_{STRN}>-Y_{STRN}$.

By Huygens' approximation formula, it is found that:

$$S=\frac{8L'-L}{3} \quad \text{eq. (1)}$$

But, as noted above, $L=S-Y_{STRN}$, or $S=L+Y_{STRN}$, and substituting this relationship into equation (1) we have:

$$L+Y_{STRN}=\frac{8L'-L}{3} \quad \text{eq. (2)}$$

But, also as noted above $L=Y_{SPAN}-Y_{STRN}$, and substituting this relationship into equation (2) we have:

$$Y_{SPAN}=\frac{8L-(Y_{SPAN}-Y_{STRN})}{3} \quad \text{eq. (3)}$$

or

$$3Y_{SPAN}=8L'-Y_{SPAN}+Y_{STRN} \quad \text{eq. (4)}$$

Now, solving for L' , we have:

$$8L'+Y_{SPAN}-Y_{STRN} \quad \text{eq. (5)}$$

or

$$L'=\frac{1}{2}Y_{SPAN}-\frac{1}{8}Y_{STRN} \quad \text{eq. (6)}$$

Referring to one of the right triangles in FIG. 2A, which has been shown separately and enlarged in FIG. 2B and employing the Pythagorean Theorem for Right Triangles ($c^2=a^2+b^2$), it will be seen that we obtain

$$(L')^2+(L/2)^2+D^2 \quad \text{eq. (7)}$$

Since D is equal to the deflection of the center of the resiliently deformable plate 21, Z_{DEF} , we can substitute Z_{DEF} for D in equation (7) and by transposing we have:

$$(Z_{DEF})^2=(L'^2-(L/2)^2) \quad \text{eq. (8)}$$

Remembering that $L'=\frac{1}{2}Y_{SPAN}-\frac{1}{8}Y_{STRN}$ and that $L=Y_{SPAN}-Y_{STRN}$ then becomes:

$$(Z_{DEF})^2+(\frac{1}{2}Y_{SPAN}-\frac{1}{8}Y_{STRN})^2-Y_{SPAN}+Y_{STRN} \quad \text{eq. (9)}$$

or

$$(Z_{DEF})^2=\frac{1}{4}(Y_{SPAN})^2-\frac{1}{4}Y_{SPAN}Y_{STRN}+\frac{1}{64}(Y_{STRN})^2-\frac{1}{4}(Y_{SPAN})^2+\frac{1}{2}Y_{SPAN}Y_{STRN}-\frac{1}{4}(Y_{STRN})^2 \quad \text{eq. (10)}$$

or

$$(Z_{DEF})^2=\frac{3}{8}Y_{SPAN}Y_{STRN}-\frac{15}{64}(Y_{STRN})^2 \quad \text{eq. (11)}$$

or

$$(Z_{DEF})^2=\frac{24Y_{SPAN}Y_{STRN}-15(Y_{STRN})^2}{64} \quad \text{eq. (12)}$$

Solving for Z_{DEF} we have,

$$Z_{DEF}=\frac{\sqrt{24Y_{SPAN}Y_{STRN}-15(Y_{STRN})^2}}{8} \quad \text{eq. (13)}$$

As an example, let us suppose the $Y_{SPAN}=2.0''$ and that the weight of a given wheel 11 causes the weigh rail 13 to deflect from its original position, such that $Y_{STRN}=0.00010$ inches. As seen by substituting these values into equation (13), we have

$$Z_{DEF}=\frac{\sqrt{24(2.0'')(0.00010'')-15(0.00010'')^2}}{8}$$

or

$$Z_{DEF}=\text{inches.}$$

Now taking the ratio of Z_{DEF} (deflection of the center of the resiliently deformable plate 21) and Y_{STRN} (vertical amount of downward deflection of crown portion 14), we find

$$\frac{Z_{DEF}}{Y_{STRN}}=\frac{0.00866''}{0.00010''}=86.6:1$$

Thus, it can be seen that a very small crown portion deflection results in a relatively large deflection at the center of the resiliently deformable plate which is highly advantageous achieving greater weight sensitivity than heretofore possible.

Reference is now made to FIGS. 3 through 7 which depict several different embodiments of the present invention in which the aforementioned transducing means may be incorporated either as an analogue device or as a digital device.

Turning to FIGS. 3 and 3A, it is noted that FIG. 3 illustrates the weigh rail of the present invention employing a plurality of

bank of associated movable and stationary electrical contacts. While it will be noted that a bank of three contacts 20, 25 and 30 is shown in FIG. 3, it will be understood that a greater or lesser number of contacts may be utilized in practicing this invention. In order to protect the resiliently deformable plate 21, and the transducing means from dust, dirt and other adverse conditions, it is advantageous to fully enclose slot 17. A first cover 36 in FIG. 3A, is shown secured by bolts 37 and 38 to the outer side of the weigh rail 13 and a second cover 33 and weather tight seal member 42 are securely held in place by screws 34 and 35. It will be noted that the covers 36 and 33 and the seal member 42 are appropriately mounted such that they do not impair the downward deflection of the crown portion 14 of weigh rail 13.

As previously mentioned, there is a bank of three normally open contact pairs 20, 25 and 30 each of which is vertically displaced or staggered with respect to one another. As shown, each of the three contacts comprises a movable contact element 23 and a stationary contact element 24. Each of the resiliently movable contact springs 23 and the stationary contact springs 24 are shown held in insulative relationship by means 28a and 28b respectively to the inner and outer insulating blocks 26 and 27 which, in turn, are secured to the flange portion 16 by means of bolts 29. It will be noted that a pair of suitable wires or leads 31 and 32 are electrically coupled to the movable and stationary contact elements of each of the three contact pairs. It will be appreciated that the leads 31 and 32 may be appropriately connected to any suitable supervisory apparatus, such as, an automatic retarder contacting system in classification yards. As mentioned, the three contact pairs 20, 25 and 30 are vertically positioned relative to each other so that a different level of displacement of the resiliently deformable means 21 is required to close each contact pair. Accordingly, such an arrangement provides a digital method of determining various weights of vehicles being processed. That is, with the maximum deflection of the resiliently deformable plate 21 occurring at its center, and with the deflection of the resiliently deformable plate 21 geometrically decreasing on either side of its center dependent upon the point selected, the three contact pairs 20, 25 and 30 will be additively closed upon the vehicle weight.

Each of the contact elements is formed of suitable resilient conductive material, such as beryllium copper, and includes a first vertical supporting portion, a horizontal intermediate portion and a second vertical contact portion. The second vertical portion of each movable contact element also includes a contiguous abutment in the form of a hook or turned over portion for cooperating with the resiliently deformable plate 21. In the present arrangement, a "lightweight" vehicle will only cause contact pair 20 to be closed, a "mediumweight" vehicle will cause both contact pairs 20 and 25 to close and a "heavyweight" vehicle will cause all three contact pairs 20, 25 and 30 to close. As previously mentioned, a contact arrangement employing a greater number of contact pairs will produce a greater number of weight classes thereby achieving a greater degree of weighing accuracy.

Referring now to FIG. 4, there is illustrated another embodiment of the invention which utilizes a flat metal plate 41 in place of the bank of three contact pairs. The metallic plate 41 is preferably constructed of suitable conductive material, such as aluminum or copper and is positioned in spaced relationship with the resiliently deformable metallic plate 21. As in the embodiment shown in FIG. 3A, the metallic plate 41 is insulated from the weigh rail section by inner and outer insulating blocks 26a and 27a. The insulative blocks 26a and 27a are securely fastened to the flange portion 16 by suitable bolts, only one of which is shown at 29a. A first lead-in wire 31a is directly coupled to the metallic plate 41 through a bolt 28a which rigidly secures the metallic plate 41 between the insulative blocks 26a and 27a while a second lead-in wire 32a is connected to bolt 28b. In this embodiment the bolt 28b passes completely through the insulative blocks 26a and 27a

as well as through member 42 and thereby engages the flange portion 16. Thus, the lead wire 32a is conductively connected through bolt 28b and flange portion 16 to the resiliently deformable metallic plate 21. The remainings, such as, the protective coverings for the slot 17 are the same as those described in the previous weigh rails. As in the weigh rail of FIG. 3, whenever a vehicle wheel moves on to the crown portion 14 of rail section 13 shown in FIG. 4, the crown portion 14 will deflect causing a proportional amount of deflection of the resiliently deformable metallic plate 21. Thus, it can be seen that the spacing between the resiliently deformable metallic plate 21 and the metallic plate 41 will decrease from the original positions as shown in FIG. 4. It will be appreciated that the spacing will vary in accordance with the weight of the vehicle. Thus, it will further be appreciated that the plates 21 and 41 may be employed as a capacitor. That is, since the capacitance value is dependent upon the spacing between plates 21 and 41, and, in turn, upon the amount of deflection of the deformable plate 21, an analogue indication of vehicle weight may be measured by connected leads 31a and 32a to a capacitance bridge or the like.

Reference is now made to FIG. 5 which illustrates another embodiment of a weigh rail in accordance with the present invention. As shown, the transducing means now takes the form of a fluidic back pressure sensor 46. The fluidic back pressure sensor 46 may be of the type manufactured by Pitney-Bowes, and listed as Pat No. 6,080,008 which includes a single input and a pair of outputs. A supply of air at a predetermined pressure is normally delivered to the back pressure sensor 46 via input conduit 47. When the discharge hole of output conduit 48 is unobstructed as shown in FIG. 5, the air supplied to the input conduit 47 will all flow through the discharge hole. However, when an obstacle partially or completely blocks the discharge hole the supply of air will be "backed-up" or diverted and will begin flowing through output conduit 49 of back pressure sensor 46. The amount or pressure of air flowing through output conduit 49 can therefore be used as an analogue indication of the nearness of an obstacle to the discharge hole of conduit 48. Thus, by employing the deformable plate 21 as the discharge controlling obstacle, the weight of a vehicle on rail section 13 can be accurately measured in accordance with the amount of deflection of the resiliently deformable plate 21. In this case, the greater the vehicle weight, the greater will be the deflection of the resiliently deformable plate 21, and, therefore, the amount of air through output conduit 48 will be smaller while the degree of "back pressure" through the output conduit 48, and the amount of air and pressure through output conduit 49 will be greater. As shown, back pressure sensor 46 is rigidly held in alignment with the resiliently deformable plate 21. The sensor 46 includes a suitable arm or bracket 50 which is interposed between a pair of shock absorbent mounting blocks 26b and 27b which, in turn, are held in place by bolts 29b and 29c. The remaining elements such as the covers for the slot 17 of this embodiment are substantially the same as described above. It should be understood that while an air supply is used in conjunction with the back pressure sensor 46, other available fluids and supply sources may equally well be employed without impeding weigh rail accuracy.

Turning now to FIGS. 6 and 6A, there is shown a fluidic digital version of a weight rail similar to FIGS. 3 and 3A in which the transducing means takes the form of a plurality of individual fluidic back pressure switches. It will be noted in view of FIG. 6A that a plurality of back pressure switches 63, 64 and 65 are disposed longitudinally along rail 13. The switch 63 is disposed in alignment with the longitudinal centerline of the resiliently deformable plate 21 while the remaining two switches 64 and 65 are disposed at some point below the centerline. Each of the back pressure switches 63, 64 and 65 includes an input conduit, a pair of output conduits and a control conduit. As shown, the back pressure switches are carried by separate bracket 56 which is resiliently mounted to

the flange portion 16 by means of an inner and an outer shock absorbent mounting block 57 and 58 through which a plurality of bolts 59 and 60 pass and securely hold switches 63, 64 and 65 in proper relationship with deformable plate 21. A supply of air is normally delivered to the back of each pressure switch via input conduits 52. Normally, whenever a control conduit 53 is totally blocked or obstructed, air will no longer flow through output conduit 54 but will flow through output conduit 55. That is, when the resiliently deformable plate 21 is in the position as shown in FIG. 6, air pressure is available on all of output conduits 54, and none of the control conduits 53 is obstructed by the resiliently deformable plate 21. Now when a "lightweight" vehicle passes onto weigh rail 13, the deformable plate is arranged to obstruct the control conduit 53 of switch 63 so that air pressure mediumweight" switched from output conduit 54 to output conduit 55. Since the resilient deformable plate 21 will deflect more and more further outwardly under increasing loads, the back pressure switches 64 and 65 are arranged to assume their obstructing or blocking positions of the control conduits 53 under medium and heavyweight cars, respectively. Hence, the plurality of back pressure switches 63, 64 and 65 cooperate with the resiliently deformable plate 21 to provide a digital method of determining three levels of vehicle weight, similar to the electrical contact arrangement of FIGS. 3 and 3A. While FIG. 6A depicts only three back pressure switches vertically displaced at and below the centerline of resiliently deformable plate 21 to indicate "lightweight," "mediumweight" and "heavyweight" vehicles, it will be understood that a greater or lesser number of back pressure switches may be used in practice in this invention. Further, it should be noted that the back pressure switches may be disposed above the centerline with the same results and achieve a greater degree of weighing accuracy. It has been found that a suitable type of back pressure switch may be of the type manufactured by Corning Fluidic Products Division described in Catalog No. 191,473.

FIG. 7 shows another embodiment of my invention in which the transducing means is a variable resistor or rheostat 67. As shown, C-shaped operating cam 68 is interposed between the resiliently deformable plate 21 and the variable resistor 67. The C-shaped cam 68 intimately contacts the resiliently deformable plate 21 and is mechanically coupled to a rotatable shaft 81 which varies the resistance of resistor 67. The variable resistor 67 is secured to one end of a suitable bracket 69, the other end of which is held between inner and outer resilient mounting blocks 72 and 73. A pair of bolts 74 and 76 is secured to the mounting blocks 72 and 73 and also the other end of bracket 69 to the flange portion 16 of rail section 13. Now whenever a wheel passes over rail section 13 and particularly over slot 17, the resiliently deformable plate 21 will cause the C-shaped cam 68 to rotate about the shaft 81 so that the change in resistance of the variable resistor 67 is proportional to the weight of the passing vehicle. The resistance change of the variable resistor 67 provides an analogue indication of the weight of the railway vehicles. This resistance change may be readily measured by any suitable means, such as an ohmmeter which can be easily connected to leads 78 and 79.

As previously mentioned, it will be noted that the plurality of contact pairs of FIGS. 3 and 3A and the plurality of back pressure switches of FIGS. 6 and 6A provide digital indications of vehicle weight, while the variable capacitive arrangement of FIG. 4, the back pressure sensor arrangement of FIG. 5 and the variable resistor arrangement of FIG. 7 provides analogue indications of vehicle weight. Further, it will be noted that any suitable conversion means for converting the electrical and fluidic indications into useable data for automatic classification yard operations may be employed with my invention.

Thus, it is apparent that the new and improved weigh rail arrangements of the present invention provide a more effective and mechanically unique method for measuring weights of vehicles which is inexpensive, compact, and more sensitive to weight changes.

I claim:

1. A weigh rail having a crown, a web and a flange portion, a slot formed between said crown and flange portions and extending transversely through said web portion, said slot having a relatively long dimension disposed longitudinally along said rail, a resiliently deformable means interposed between the upper and lower surfaces of said slot, said resiliently deformable means being deflected in conjunction with a deflection of said crown portion of said rail such that the direction of motion of said deflection of said resiliently deformable means is orthogonal to the direction of motion of said deflection of said crown portion, and a transducing means cooperatively associated with said resiliently deformable means and responsive only to the orthogonal deflection of said resiliently deformable means for providing an indication of the amount of said deflection of said crown portion.

2. A device for weighting objects moving over a section of track, said track having an upper movable, an intermediate web, and a lower stationary portion, a slot formed between said upper and lower portions and extending transversely through said intermediate portion, said slot having a relatively long dimension disposed longitudinally along said section of track, a resiliently deformable plate interposed between the upper and lower surfaces of said slot, said resiliently deformable plate being deflected in conjunction with a deflection of said upper movable portion of said section of track, caused by the passing of said object, such that the direction of motion of said deflection of said resiliently deformable plate is orthogonal to the direction of motion of said deflection of said upper movable portion, and a transducing means cooperatively associated with said resiliently deformable plate and responsive only to the orthogonal deflection of said resiliently deformable plate for providing an indication of the amount of said deflection of said upper movable portion according to the weight of said object.

3. The weigh rail of claim 1 wherein said transducing means comprises a bank of electrical contacts in vertically staggered alignment with said resiliently deformable means, the closing of any one of said electrical contacts dependent upon the amount of deflection of said resiliently deformable means due to the amount of deflection of said crown portion of said rail.

4. The weigh rail of claim 2 wherein said resiliently deformable means is a metal plate and said transducing means is a static metal plate in such alignment with said resiliently deformable means as to form a variable capacitive device, the capacitance of said variable capacitive device varying according to the amount of distance between said resiliently deformable means and said static plate, said distance varying according to the amount of deflection of said resiliently deformable means.

5. The weigh rail of claim 1 wherein said transducing means is a plurality of back pressure switches, each of said switches having at least one input conduit, and first and second output conduits and a control conduit, said control conduits in vertically staggered alignment with said resiliently deformable means, said supply input providing a continuous flow of fluid at a predetermined pressure such that whenever said control conduit is free from obstruction by said resiliently deformable means, there will be an indication at said first output conduit, and whenever said control conduit is obstructed by said resiliently deformable means there will be an indication at said second output conduit, and the obstructing of any one of said control conduits dependent upon the amount of deflection of said resiliently deformable means due to the amount of deflection of said crown portion of said rail.

6. The weigh rail of claim 1 wherein said transducing means is a back pressure sensing device having an input conduit, and first and second output conduits, said input conduit providing a continuous flow of fluid at a predetermined pressure, said first output conduit and said resiliently deformable means initially separated, at zero deflection of said resiliently deformable means, by a predetermined distance such that a zero deflection of said first output conduit will allow a

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maximum flow of fluid and no fluid flow from said second output conduit and as said predetermined distance decreases due to deflection of said resiliently deformable means, said first output conduit will decreasingly allow fluid to flow therefrom while said second output conduit will increasingly allow air to flow therefrom.

7. The weigh rail of claim 1 wherein said transducing means is a variable resistance such that the deflection of said resiliently deformable means causes a proportional change in said variable resistance.

8. The weigh rail of claim 1 wherein the amount of deflection of said resiliently deformable means at its center, due to the amount of deflection of said crown portion of said rail is given by the equation,

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$$Z_{DEF} = \frac{\sqrt{24Y_{STRN}Y_{SPAN} - 15(Y_{STRN})^2}}{8}$$

5 where: Z_{DEF} =deflection of said resiliently deformable means at its center

Y_{STRN} =downward deflection of said crown portion of said rail

and: Y_{SPAN} =height of said slot at zero deflection.

10 9. The weigh rail of claim 1 wherein said transducing means is an analogue device.

10. The weigh rail of claim 1 wherein said transducing means is a digital device.

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