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Raynes

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[54] **CONVEYOR WEIGHING SCALE**

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[52] **U.S. Cl.** ..... **177/52,** 177/210, 73/141 A

[51] **Int. Cl.** **G01g 13/00**

[58] **Field of Search** ..... 177/52, 116, 119, 200, 177/201–202, 210, 211, 212, 225, 229; 73/141 A, 141 R, 141 AB

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Attorney, Agent, or Firm—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

A weigh device comprising at least two substantially parallel diaphragms secured in overlying and vertically spaced relationship by a support frame, the diaphragms being substantially rigid in the planes of their extent and having a degree of flexibility in a direction normal to such planes; rigid coupling means extending between and secured to the diaphragms at a position remote from the support frame; a substantially horizontal platform rigidly secured relative to, and in substantially vertical alignment with, the coupling means, said platform being intended to receive an article to be weighed; and a measuring device responsive to vertical displacement of, or vertical loading on, the coupling means relative to the support frame as a result of an article being supported on the platform from which displacement or loading the weight of the article may be determined.

5 Claims, 7 Drawing Figures

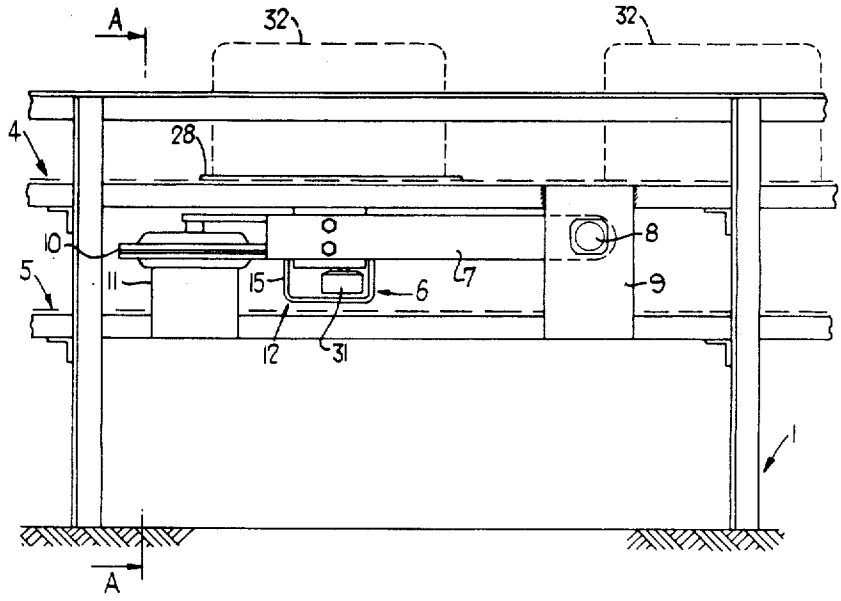


FIG.1.

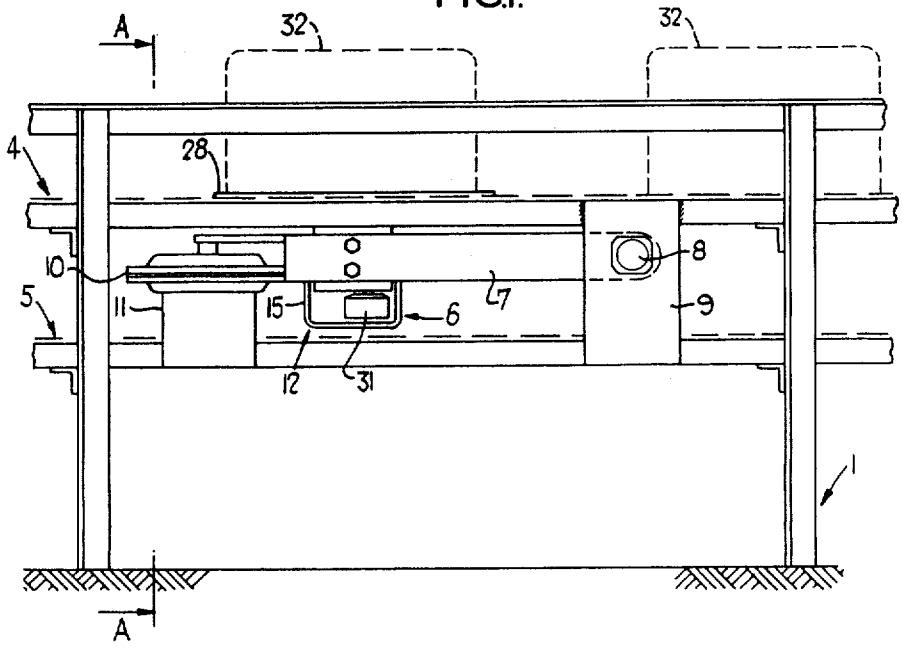


FIG.2.

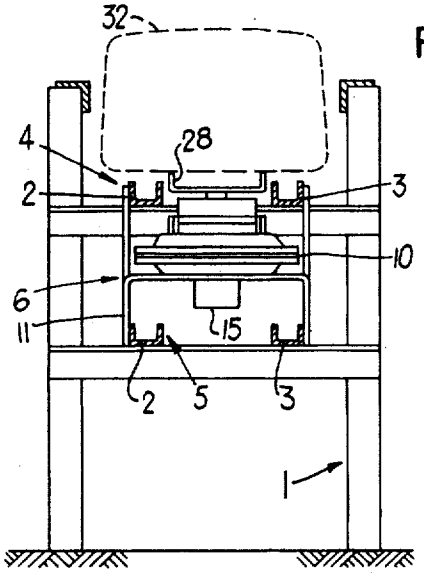


FIG.3.

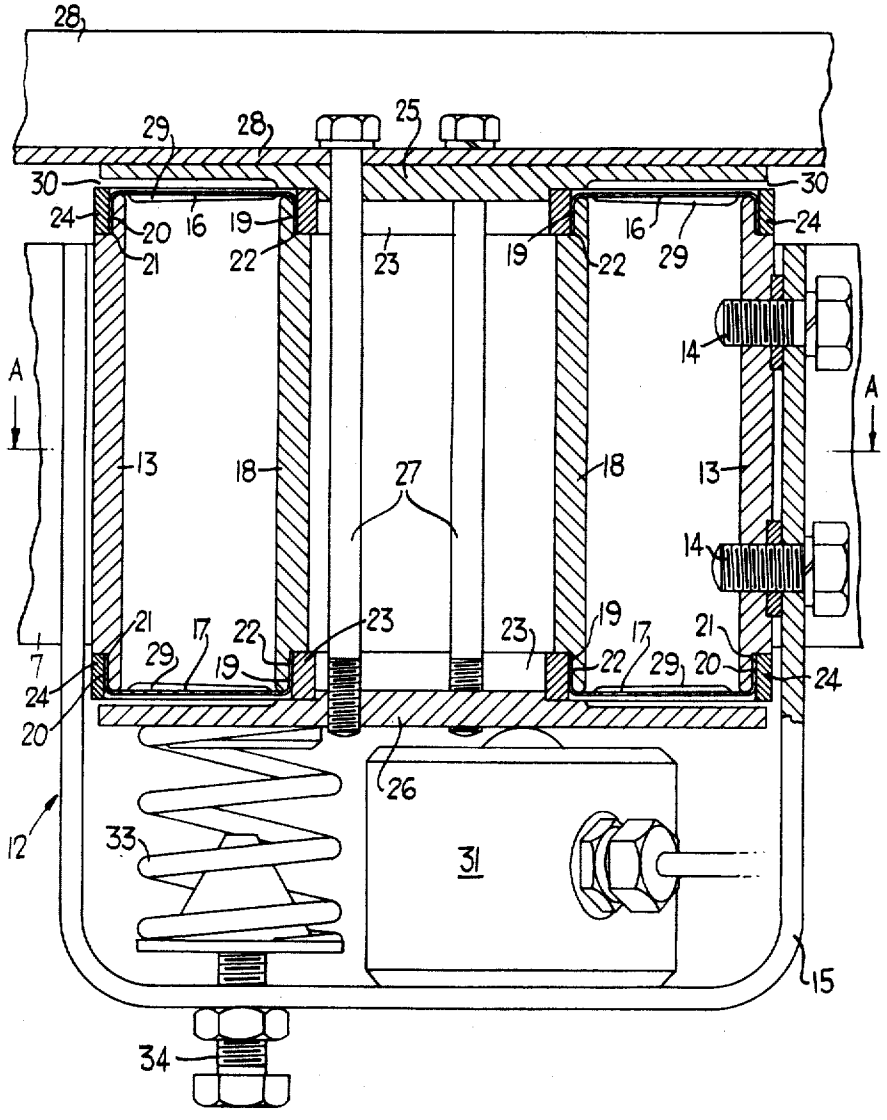
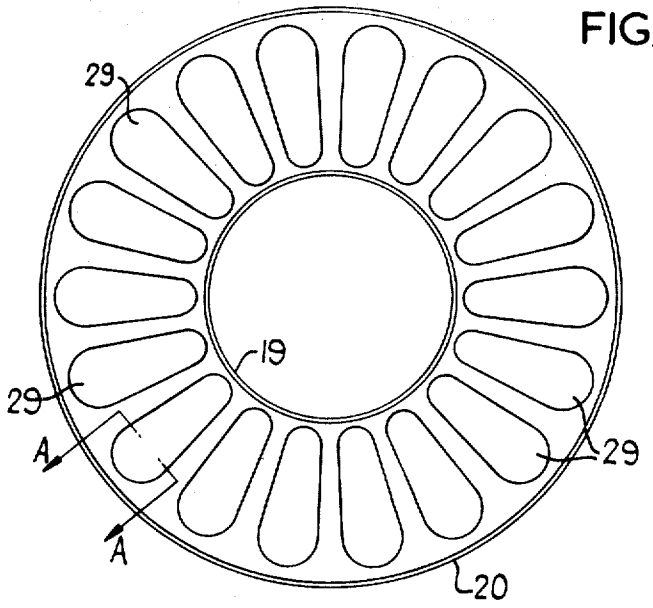

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FIG.4.



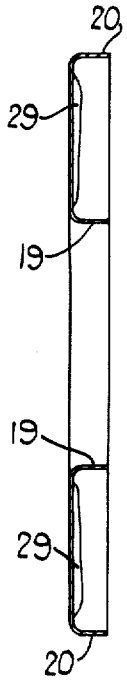


FIG.5.

FIG.6.

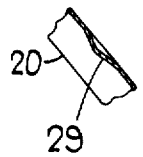
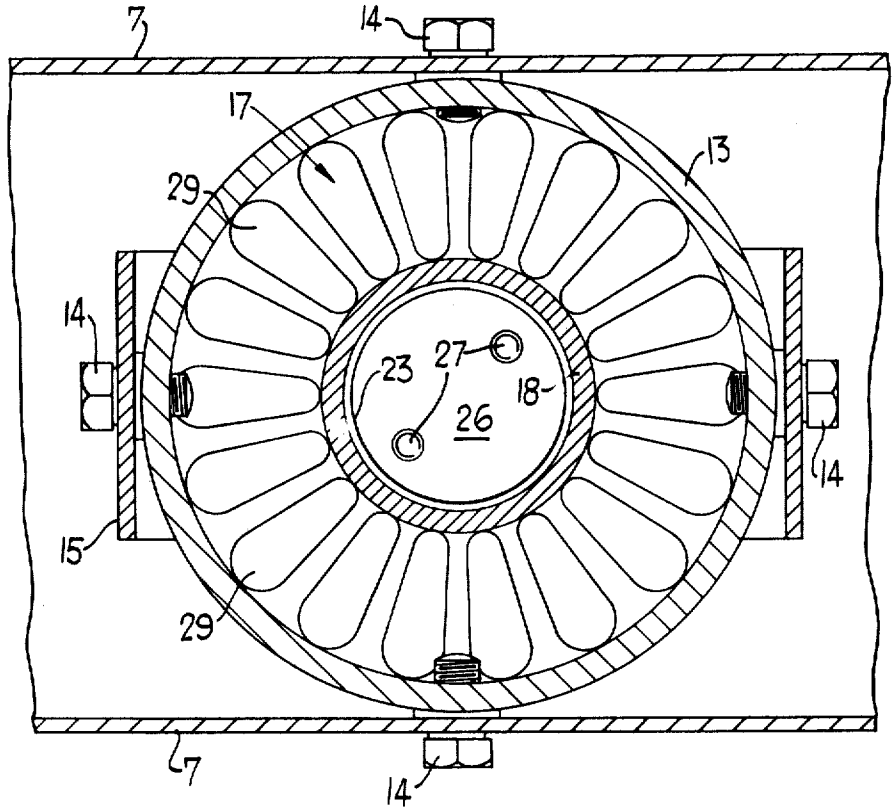


FIG.7.



CONVEYOR WEIGHING SCALE

This invention relates to a weigh device of the type having a substantially horizontal platform which is intended to support articles for the purpose of weighing.

More particularly the invention is concerned with such a type device which is primarily intended for use in situations where articles are to be weighed individually at a high rate and such articles are to be moved serially on to and off the platform in a substantially horizontal direction. In this latter type of weigh device, as an article moves onto the platform in a horizontal direction, a horizontal component of force is applied to the platform which can set the latter into resonance and if accurate weighing of the article is to be achieved it is necessary to wait until this vibration has ceased (or virtually so). Consequently precautions are often taken to ensure that the articles are deposited on the platform in a manner which avoids setting the platform into horizontal vibration or alternatively the platform may be constructed to have a high resonant frequency in the horizontal direction. A weigh device of the type mentioned is frequently incorporated in a conveyor system to weigh articles being transported on a conveyor of the kind having an open centre, that is to say the conveyor has a pair of endless parallel bands or chains which are horizontally spaced. The weigh device is located beneath the upper run of the conveyor and on a suitable lift frame so that, as an article passes over the platform, the weigh device is raised to lift the article clear of the conveyor for weighing purposes. Although the conveyor can be stopped intermittently when an article is located over the platform and thereby ensure that the article is raised while stationary in a horizontal sense, this is undesirable since it necessarily reduces the transfer rate of the articles. It is therefore preferred to keep the conveyor moving and to transfer the article onto the platform as the weigh device is raised and while the article is moving in a horizontal sense. Such horizontal component of movement of the article can cause the platform to resonate and to achieve an accurate weight measurement the vibrations are usually permitted to settle down prior to the weight measurement being taken; this results in a delay in the weighing and thereby the rate at which articles are transferred on the conveyor.

It is an object of the present invention to provide a weigh device of the type mentioned which is relatively simple in construction and operation, is primarily intended for use in weighing articles raised from a conveyor, and which device will permit a high rate of weighing by alleviating the aforementioned problem of horizontal resonance in the platform due to an article being deposited thereon in a horizontal direction.

According to the present invention there is provided a weigh device comprising at least two substantially parallel diaphragms secured in overlying and vertically spaced relationship by a support frame, the diaphragms being substantially rigid in the planes of their extent and having a degree of flexibility in a direction normal to such planes; rigid coupling means extending between and secured to the diaphragms at a position remote from the support frame; a substantially horizontal platform rigidly secured relative to, and in substantial vertical alignment with, the coupling means, said platform being intended to receive an article to be weighed; and a measuring device responsive to vertical displacement of, or vertical loading on, the coupling means relative to the support frame as a result of an article being supported on the platform from which displacement or loading the weight of the article may be determined.

Further according to the present invention there is provided a weigh assembly for a conveyor which comprises a weigh device constructed in accordance with the present invention, said device being carried by a lift frame to which the support frame is secured and which lift frame is intended to be mounted with the platform underlying the conveyor, and wherein lift means is provided to raise and lower the lift frame so that the platform of the weigh device when raised can receive thereon articles from the conveyor for weighing purposes.

Still further according to the present invention there is provided a conveyor system comprising an endless conveyor and a weigh device constructed in accordance with the present invention, said weigh device being carried by a lift frame to which the support frame is secured and so that the platform, in a non-weighing condition, underlies the conveyor, and lift means for raising and lowering the lift frame so that, as the lift frame is raised, the weigh device will move to lift an article from the conveyor to transfer the weight of that article on to the platform for weighing purposes.

Preferably the rigid coupling means is positioned within the confines of the support frame.

Generally the conveyor will be of the aforementioned "open-centre" kind and the platform is intended to be raised through the open-centre for weighing purposes. Alternatively however the conveyor may be of a single belt or other closed centre kind in which case the platform may be of U-shape or other form to straddle the conveyor and be raised on both sides thereof to lift from the conveyor an article which overlaps the width of the conveyor.

By the weigh device of the present invention, particularly in its application for weighing articles transferred to the platform from a horizontal conveyor, the horizontal component of force which may be transferred from the article to the platform and thereby tend set the latter into horizontal resonance is rapidly dissipated due to the horizontal rigidity of the diaphragms. These diaphragms render the weigh device with a very high resonant frequency and heavy damping in the horizontal sense so that weighing can take place almost immediately after the article has been deposited on the platform.

The diaphragms are conveniently of circular form in plan and may be located at the ends of a tubular cylindrical support frame with the rigid coupling means (such as a rod, tube or bar) located within the confines of the tubular support frame and co-axial therewith. Although two diaphragms will generally be sufficient, three or more diaphragms may be provided for weighing heavy articles, each such diaphragm being secured between the support frame and the coupling means.

The measuring device may provide a direct measurement of load applied to the platform (and thereby to the coupling means) and may be in the form of a load cell, hydraulic weigh cell, or the like. Alternatively the measuring device may be responsive to vertical displacement of the coupling means which displacement will provide an indication of the applied load from which the weight of an article may be determined, for example electro-magnetically, by transducers or by a

purely mechanical spring device. It is to be realised that when using a load cell or similar measuring device, although the coupling means and diaphragms will be displaced vertically as the platform is loaded, such displacement may be in the order of thousandths of an inch and the loading will largely be taken by the measuring device rather than by the diaphragms. Alternatively the diaphragms may be used to sustain the major part of the applied load provided that their vertical displacement as a result of such loading does not cause them to be overstrained.

One embodiment of a weigh device constructed in accordance with the present invention and as applied to a conveyor system will now be described, by way of example only, with reference to the accompanying illustrative drawings in which:

FIG. 1 is a side elevation of part of the conveyor system;

FIG. 2 is a section of the conveyor system taken on the line A—A of FIG. 1;

FIG. 3 shows in part section, the weigh device incorporated in the conveyor system shown in FIGS. 1 and 2;

FIG. 4 is a plan view of a diaphragm incorporated in the weigh device of FIG. 3;

FIG. 5 is a side elevation of the diaphragm shown in FIG. 4;

FIG. 6 is a scrap view taken on the line A—A of the diaphragm shown in FIG. 4, and

FIG. 7 is a section of the weigh device taken on the line A—A of FIG. 3.

The conveyor system comprises a rigid framework structure 1 which carries an endless conveyor of the open-centre kind formed by a pair of horizontally spaced and parallel link chains running in channel supports 2 and 3 to provide an upper conveyor run 4 and a lower return run 5.

Incorporated in the conveyor system is a weigh assembly shown generally at 6. This assembly 6 comprises a lift frame 7 which is located between the upper and lower runs 4, 5 of the conveyor and is pivotally mounted at 8 to side plates 9 on the structure 1. The pivotal connection 8 of the lift frame with the side plates 9 is preferably made through a block of resilient material (such as rubber or similar elastomeric material) for damping purposes. Pivotal movement of the lift frame 7 is effected by lift means in the form of a fluid pressure operated (conveniently a pneumatic diaphragm) lift device 10. The device 10 is mounted on a bracket 11 of the structure 1 below the lift frame 7 so that when it is pressurised the lift frame is displaced upwardly towards the upper run 4 of the conveyor. The weigh assembly 6 has a weigh device shown generally at 12 which is carried by the lift frame 7 to be raised and lowered as the lift frame is pivoted about 8.

Referring now to FIG. 3, the weigh device 12 has a support frame in the form of a cylindrical tube 13 which is rigidly secured by bolts 14 to a U-shaped housing 15 which forms part of the lift frame 7. Secured at axially opposite ends of the tubular support frame 13 are a pair of annular diaphragms 16, 17. These diaphragms are parallel to each other and extend generally radially between the support frame 13 and a rigid coupling member formed by a cylindrical tube 18 which is located within the confines of the support frame 13 to be co-axial therewith.

The diaphragms 16 and 17 are similarly formed as shown in FIGS. 4 to 6 and each has an inner circumferential axially extending flange 19 and an outer circumferential axially extending flange 20. To receive the diaphragms, each end of the tubular support frame 13 is provided with an annular rebate 21 on the external circumferential surface thereof, and each end of the tubular coupling member 18 is provided with an annular rebate 22 on the internal circumferential surface thereof. The flanges 19 and 20 of the two diaphragms are received in the rabates 21 and 22 as shown in FIG. 3 and are secured thereto by inner and outer concentric clamping rings 23 and 24 which are respectively received in the annular rebates 22 and 21. The pair of inner clamping rings 23 are retained in their respective rebates between upper and lower end plates 25 and 26 respectively which plates are secured together as by bolts 27. The bolts 27 are conveniently used to secure a weigh platform 28 to the upper end plate 25 and thereby ensure that the weigh platform 28 is fixed relative to the tubular coupling member 18.

The diaphragms 16 and 17 are formed to be substantially rigid in the planes of their extent, that is generally radially of the tubular members 13 and 18. However the diaphragms have a degree of flexibility in the axial direction of the tubular members 13 and 18. For the purpose of increasing their radial rigidity, each of the diaphragms 16 and 17 is provided with an array of circumferentially spaced and radially extending depressions 29. Generally the diaphragms will be of metal (such as phosphor bronze or stainless steel sheet) and as such may conveniently be formed by a stamping or pressing operation. While being rigid in a radial sense, the diaphragms must exhibit a degree of flexibility in the axial sense; this flexibility required of the diaphragms is in the order of thousandths of an inch. To ensure that the diaphragms are not over-strained if the coupling member 18 is moved axially relative to the support frame 13, the end plates 25 and 26 are adapted to abut the support frame 13 (or more accurately the outer clamping rings 24) during such axial displacement, thereby restricting the degree to which the diaphragms may be flexed axially. However, it will be noted that, with the diaphragms in a normal unflexed condition, a necessary clearance 30 is provided between the upper end plate 25 and the upper clamping ring 24.

Mounted on the housing 15 to underlie and engage with the lower end plate 26 is a load cell 31. This load cell is conveniently of a conventional type which employs an integral diaphragm force summing member with bonded foil strain gauges and incorporates a bridge configuration which provides an electrical output proportional to the applied load, from the electrical output a weight measurement can be determined in known manner.

As an article 32 (for example a beer keg or cask) is moved by the conveyor chains to a position in which it overlies the platform 28, the lift frame 7 is pivoted by the lift device 10 to raise the article 32 from the conveyor chains on the weigh platform 28 as shown in FIGS. 1 and 2. The degree of pivotal movement of the lift frame 7 need only be a matter of inches provided that it is sufficient to move the platform 28 from a first position in which the article 32 can be moved unrestricted by the conveyor over the top of the weigh platform to a second position in which the article is raised

on the weigh platform 28 slightly above the conveyor chains; in this latter position, the weigh platform 28 and diaphragms are horizontal and the coupling member 18 vertical. With the weigh assembly 6 raised to the operative condition shown in FIGS. 1 and 2, the weight of the article 32 on the platform 28 acts to displace the tubular coupling member 18 and thereby the diaphragms 16 and 17 vertically downwardly relative to the support frame 13 and against the load cell 31 by which latter the weight of the article 32 is then determined. The amount of axial (vertical) depression is in the order of ten thousandths of an inch thereby ensuring that the diaphragms are not strained in an axial sense.

Since the article 32 is moved onto the platform 28 in a horizontal direction, it will be apparent that a horizontal component of force is applied to the platform and as a result the diaphragms 16 and 17 are subjected to radially extending forces (through the coupling member 18). However, since the diaphragms are substantially rigid in a radial sense and have a high resonant frequency in the horizontal plane a heavy damping effect is provided on the platform 28 thereby ensuring that any vibration of the platform in a horizontal direction rapidly ceases and the article can be weighed almost immediately after being raised from the conveyor.

After the article has been weighed the lift frame 7 is lowered by the lift device 10 thereby returning the article to the conveyor chains for further transfer and the next article may then be raised for weighing as soon as it overlies the platform 28. As the conveyor is running continuously, suitable means may be provided to hold up the articles prior to them being weighed (for example, if the articles are closely spaced on the conveyor) and allow them to pass through on the conveyor, one at a time, and at appropriate intervals to be weighed. Automatic rejection means can be provided which responds to a signal from the measuring device to reject the article is it is shown to be of incorrect weight.

A coil spring 33 is provided between the lower end plate 26 and the housing 15. This spring acts against the underside of the end plate 26 and its compression is adjustable by a screw device 34 so that, by varying the compression of the spring, the vertical loading of the end plate 26 on the load cell 31 may be adjusted as required. This provides a convenient means of presetting the load cell 31 (for example to give zero weight reading) prior to an article being weighed.

In the above described and illustrated embodiment the diaphragms are relatively thick and are preferably constructed so that a radial compressive stress is present. The effect of this is to provide a toggle action at the centre of the weigh device (i.e., on the coupling means) which amounts to a negative stiffness. This counteracts the inherent axial stiffness of the diaphragms and, when properly adjusted provides a substantially "rateless" (that is negligible resistance to) vertical movement over a small amount of travel (i.e., vertical displacement of the coupling member) as may be required by the load cell measuring device. By providing the depressions 29 in the diaphragms, the latter can maintain a stable shape in the presence of the radial stress.

If required the load cell 31 can be set to zero or other predetermined reading electrically as is well known in the art rather than be adjustment of the spring 33 as previously mentioned. Consequently, the spring 33 may be omitted when the load cell is adjustable electrically although even in such latter case it may be desirable to retain the spring 33, for example to provide a means of adjustment by which the load cell 31 can be used to weigh in different ranges.

I claim:

1. A weigh assembly for a conveyor which comprises a weigh device comprising at least two substantially parallel diaphragms secured in overlying and vertically spaced relationship by rigid tubular support means, the diaphragms being substantially rigid in the planes of their extent and having a degree of flexibility in the direction normal to such planes; rigid coupling means located within the confines of said tubular support means, said coupling means extending axially between and being secured to the diaphragms at positions remote from the support means and substantially centrally thereof; a substantially horizontal platform rigidly secured relative to one of said means and in substantially vertical alignment with that said means, said platform being intended to receive an article to be weighed, said article being locatable in any position over the surface of said platform; a measuring device responsive to relative vertical displacement of, or relative vertical loading on, the one said means relative to the other said means as a result of an article being supported on the platform from which displacement or loading the weight of the article may be determined; and wherein said diaphragms each have an array of radially extending reinforcing means thereon which are circumferentially spaced relative to the axis of the coupling means and provide localized stiffness in the diaphragms radially relative to said axis, each said reinforcing means having an elongated configuration and being located on its respective diaphragm with the larger dimension lying radially relative to said axis over the portion of the diaphragm between said support means and said connecting means,

said device being carried by a lift frame which is intended to be mounted with the platform underlying the conveyor, and wherein lift means is provided to raise and lower the lift frame so that the platform of the weigh device when raised can receive thereon articles from the conveyor for weighing purposes.

2. A conveyor system as claimed in claim 1 wherein the conveyor is of the open centre kind and, as the weigh device is raised, the platform is intended to pass upwardly for weighing purposes through the open centre of the conveyor.

3. A conveyor system as claimed in claim 1 wherein the conveyor is of the closed centre kind and the platform is shaped to straddle the conveyor whereby, as the weigh device is raised, the platform moves upwardly on both sides of the conveyor to lift from the conveyor an article which overlaps the width of the conveyor.

4. A conveyor system as claimed in claim 1 wherein the lift frame is raised and lowered by pivotal movement thereof and the pivotal connection of said frame is resiliently mounted.

5. A conveyor system comprising an endless conveyor and a weigh device comprising at least two substantially parallel diaphragms secured in overlying and vertically spaced relationship by rigid tubular support means, the diaphragms being substantially rigid in the planes of their extent and having a degree of flexibility in a direction normal to such planes; rigid coupling means located within the confines of said tubular support means, said coupling means extending axially be-

tween and being secured to the diaphragms at positions remote from the support means and substantially centrally thereof; a substantially horizontal platform rigidly secured relative to one of said means in substantially vertical alignment with that said means, said platform being intended to receive an article to be weighed, said article being locatable in any position over the surface of said platform; a measuring device responsive to relative vertical displacement of, or relative vertical loading on, the one said means relative to the other said means as a result of an article being supported on the platform from which displacement or loading the weight of the article may be determined; and wherein said diaphragms each have an array of radially extending reinforcing means thereon which are circumferentially spaced relative to the axis of the coupling means and provide localized stiffness in the diaphragms radially relative to said axis, each said reinforcing means having an elongated configuration and being located on its respective diaphragm with the larger dimension lying radially relative to said axis over the portion of the diaphragm between said support means and said connecting means,

said weigh device being carried by a lift frame so that the platform, in a non-weighing condition, underlies the conveyor, and lift means for raising and lowering the lift frame so that, as the lift frame is raised, the weigh device will move to lift an article from the conveyor to transfer the weight of that article on to the platform for weighing purposes.

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