

- [54]
- BALANCE USING A BEAM TYPE LOAD CELL**

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July 14, 1972	Japan.....	47-82505

- [52] U.S. Cl..... 177/196, 177/211, 177/194,
177/246, 73/141 A

- [51] Int. Cl. G01g 23/32

- [58] **Field of Search** 177/195-196,
177/210-211, 225-230, 246, 263; 73/85 R,
141 A, 141 R, 141 AB

- [56]
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[57] **ABSTRACT**

In a balance using a beam type load cell a load to be weighed is applied to the knife edge of the load cell through the wires which are each fixedly secured at one end to the load cell inwardly of and near the knife edge so that their main portions hang below the knife edge and extend across it.

6 Claims, 9 Drawing Figures

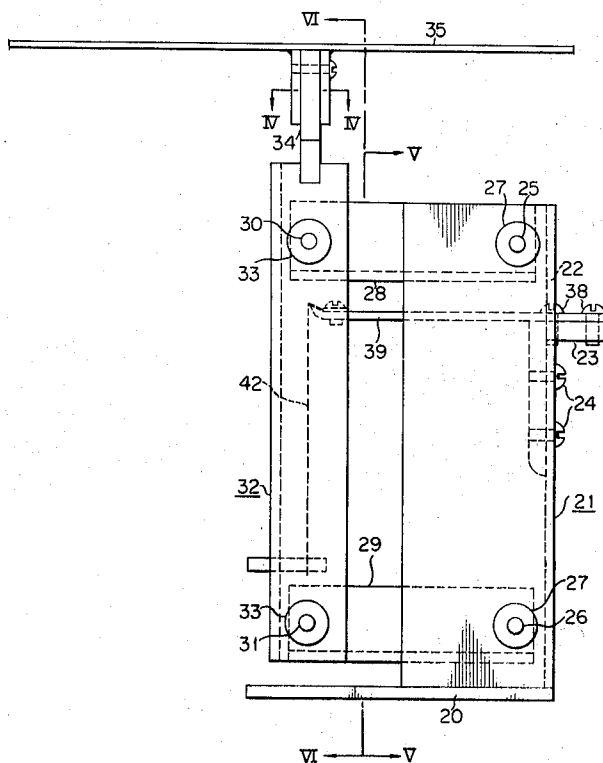


FIG. 1 PRIOR ART

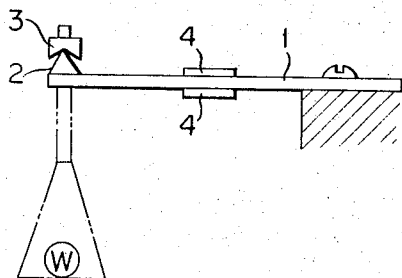


FIG. 2

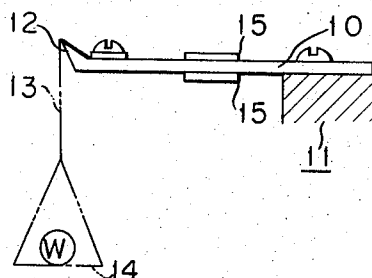


FIG. 3

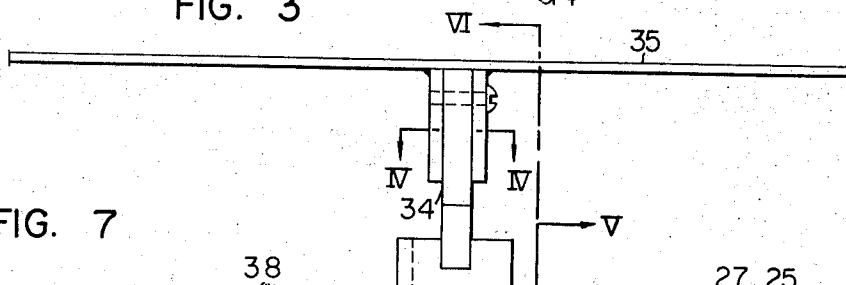


FIG. 7

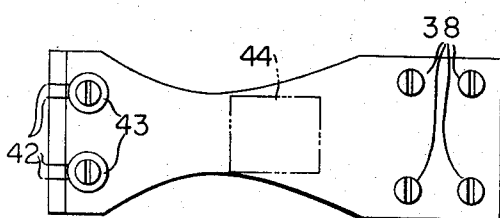


FIG. 8

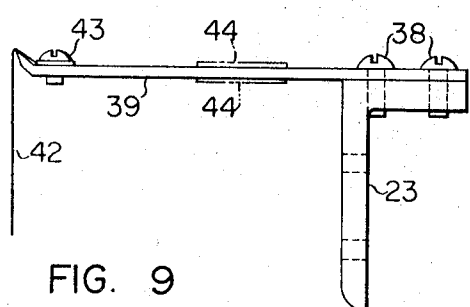
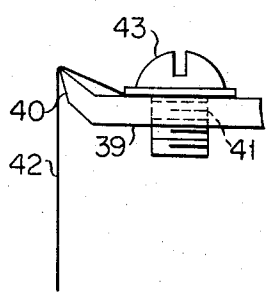
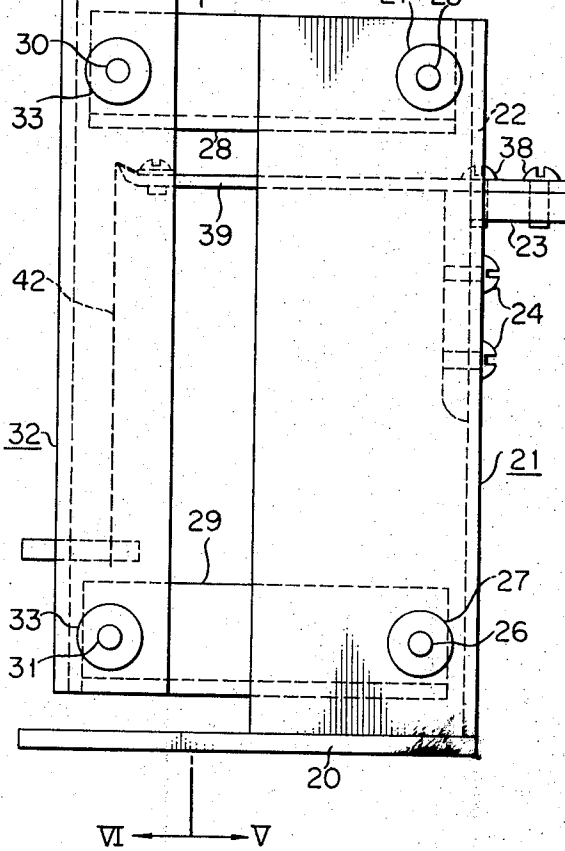


FIG. 9



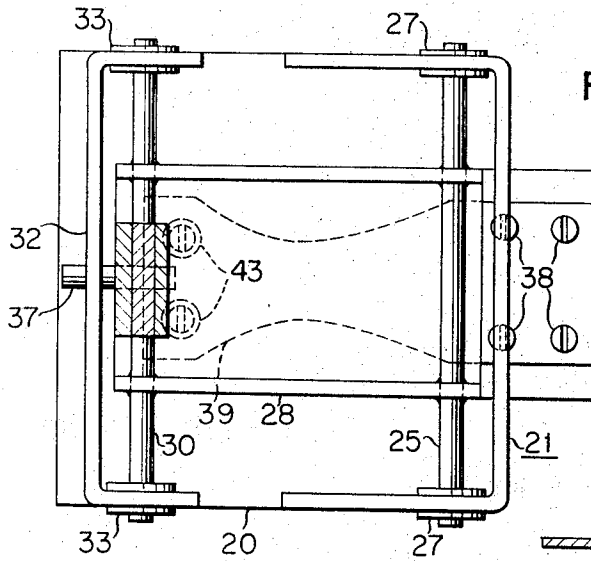


FIG. 4

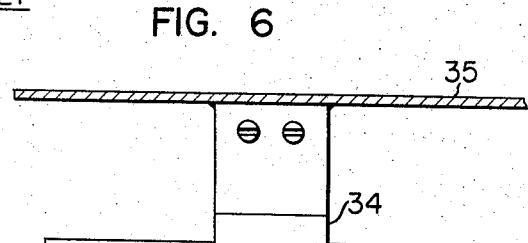


FIG. 6

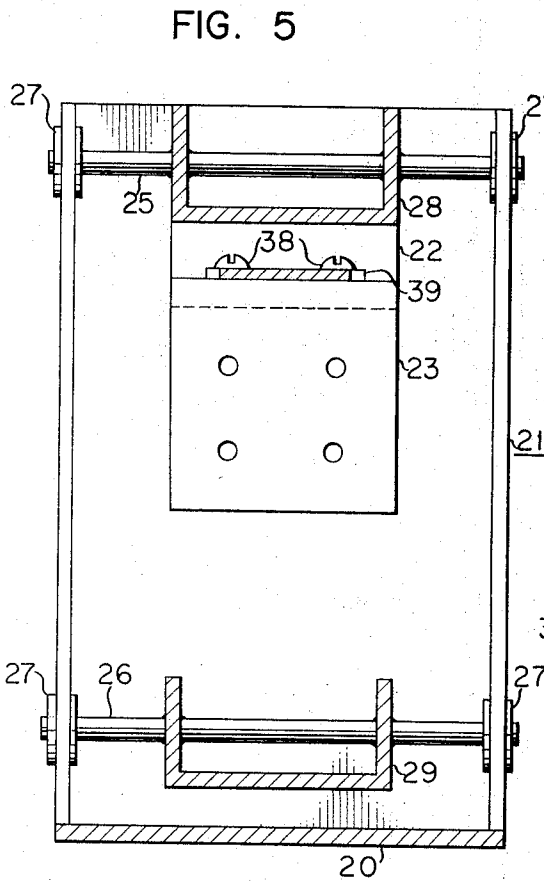
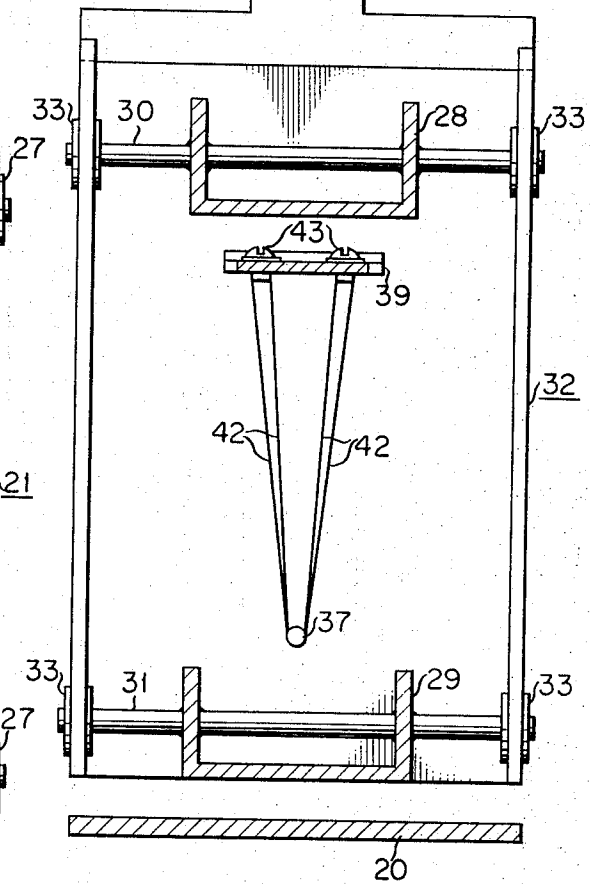


FIG. 5



BALANCE USING A BEAM TYPE LOAD CELL

BACKGROUND OF THE INVENTION

This invention relates to a balance and more particularly to a balance using a beam type load cell as a weighing element.

In the conventional balance using a beam type load cell as a weighing element, it is usual that, in order to improve the accuracy of the measurement, a knife edge is provided on the body of the load cell and a load to be weighed is applied to the load cell by the knife edge through a mounting seat. If this is diagrammatically shown taking a typical example, as shown in FIG. 1, on the upper surface of the free end of the body 1 of a beam type load cell there is a rigidly secured a knife edge 2 to which is applied a load W through a mounting seat 3 resting on its upper edge so that the load W is applied to the body 1 of the load cell. In FIG. 1 there are also shown strain gauges 4, known per se, fixedly adhered to the upper and lower surfaces of the body 1 of the load cell, to electrically measure the magnitude of the load.

However, with such an arrangement of the knife edge in a conventional beam type load cell of a balance, it is often the case that the mounting seat 3 easily comes off the knife edge 1, due to such circumstances as a small oscillation of the load, so that measurement becomes impossible, and also, due to the wear of the contact surfaces of the mounting seat 3 and the knife edge 1, there occurs a decrease in measurement accuracy.

Further, in a conventional beam type load cell used in association with a balance, it is usual that a knife edge previously prepared as an independent piece is secured to the body of the load cell at a portion adjacent to its free end by means such as a dovetail joint, or screws, etc.

However, with such an arrangement for securing the knife edge to the body of the load cell, the knife edge is often loosened during use of the balance and, in extreme cases, it may come off the body of the load cell so that measurement again becomes impossible.

Thus conventional beam type load cells used in cooperation with balances have many drawbacks.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a balance using a beam type load cell as a weighing element which can eliminate all of the drawbacks inherent in the conventional beam type load cells used in cooperation with the balance as above-mentioned.

It is a further object of the present invention to provide a balance using a beam type load cell as a weighing element in which a knife edge provided on the body of the load cell does not loosen or come off the body of the load cell during use of the balance.

It is a further object of the present invention to provide a balance using a beam type load cell as a weighing element in which the mounting seat used in cooperation with the knife edge does not come off the knife edge even if the balance is subject to oscillation.

It is a further object of the present invention to provide a balance using a beam type load cell as a weighing element in which the knife edge provided on the body of the load cell is not subjected to wear so that measurement inaccuracy, due to wear of the contact sur-

faces of the knife edge and the mounting seat, as usual in the conventional balance, is wholly excluded.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects of this invention will become more readily apparent upon reading the following specification and upon reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatical view to represent an example of a beam type load cell in cooperation with a balance;

FIG. 2 is a diagrammatical view to represent the principle of the present invention;

FIG. 3 is a side elevational view of a balance in accordance with the preferred embodiment of the present invention;

FIG. 4 is a horizontal transverse sectional view of the preferred embodiment shown in FIG. 3 taken along the line IV — IV of FIG. 3;

FIG. 5 is a vertical transverse sectional view of the preferred embodiment shown in FIG. 3 taken along the line V — V of FIG. 3;

FIG. 6 is a vertical transverse sectional view of the preferred embodiment shown in FIG. 3 taken along the line VI — VI of FIG. 3;

FIG. 7 is a plan view of the beam type load cell shown in FIG. 3;

FIG. 8 is a side elevational view of the beam type load cell shown in FIG. 7, and

FIG. 9 is a partial enlarged view of the beam type load cell shown in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 2 showing the principle of the present invention, the body 10 of a load cell made of metal plate having a generally elongated shape is fixedly secured to a stationary part 11. Integrally with the body 10 and at its free end is a knife edge 12 and one end of a wire 13 made of an appropriate material is rigidly secured to the body 10 at its upper surface near the knife edge 12 by any suitable means such as screwing, the wire 13 being suspended vertically across the knife edge 12 so that its other end is adapted to be pulled downwards by a load W to be weighed through any suitable means, such as a weighing pan 14. As is well known in the art, the body 10 of the load cell further has strain gauges 15 fixedly secured on its upper and lower surfaces by any suitable means such as adhesion between the portion where it is secured to the stationary part 11 and the portion where the wire 13 is secured to it.

In this case, a strand wire, consisting of a number of metal wires of a small diameter, is preferable as the wire 13.

Thus, according to the present invention, when the load W is applied to the free end of the wire 13 through a medium such as the weighing pan 14, it is directly transmitted to the upper edge of the knife edge 12 without going through a mounting surface, as usual in the conventional load cell, so that the body 10 of the load cell is deformed to strain the strain gauges 15, whereby the weight of load W is measured by measuring the electric current occurring in them in the usual manner. The strain gauges 15 are generally of types well known in the art and for the purpose of the present invention need not be described in any greater detail.

It will be appreciated that, in the knife edge of the present invention, since it is formed integrally with the body of the load cell, it not only unable to come off the body of load cell, but also can reduce the manufacturing cost. Moreover, in the present invention, since a mounting surface is not used in order to transmit a load to be weighed to the edge of the knife edge, the usual defects in the conventional load cells, such that the mounting surface comes off the knife edge or that wear is caused in the contacting surfaces between them, are all eliminated, so that the initial accuracy of the measurement is maintained over a long time and yet the manufacture, assembly, or adjustment, etc. are also made easy.

Next a preferred embodiment of the present invention will be explained fully making reference to FIGS. 3 to 9. Rigidly secured by any suitable means, such as welding, to one end of a base 20, which is made of an approximately rectangular metal plate is an upright 21 having an approximately channel-like crosssection. The upright 21 has a cutout 22 having a substantially rectangular shape in its web at its upper portion along its vertical center line and an L-shaped bracket 23 is fixedly secured to its vertical inner surface by any suitable means such as screws 24 in such a way that its one arm extends horizontally outwardly relative to the surface of the web of the channel-like upright 21. Two shafts 25 and 26 are rotatably supported by the confronting sides or flanges of the channel-like upright 21, at their upper and lower portions, in the overlapping relation through means such as ball bearings 27, and the shafts 25, 26 rigidly carry supports 28, 29, respectively, near their rear ends, each support having generally a channel-like crosssection with its confronting sides having extending therethrough the shafts 25, 26, respectively, whereby the webs of the supports 28, 29 are below the shafts. Extending through the confronting sides of the supports 28, 29 near their front ends are shafts 30, 31, respectively, rigidly carried by the sides or flanges.

The ends of the respective shafts 30, 31 are rotatably supported by the confronting sides of a load transmitting member 32 having generally a channel-like crosssection, through ball bearing 33 rigidly secured to the sides.

It will be understood that such construction and mounting of the load transmitting member 32 allows it to swing about the shafts 25, 26 with the web of the channel-like crosssection being always held vertically, that is, in parallel with the web of the upright 21. Fixedly secured to both sides or flanges of the load transmitting member 32, at their upper portions, by any suitable means, such as welding, is a connecting member 34 generally comprising a plate with a raised central portion so that its surface extends parallel with the web of the load transmitting member 32, and the raised portion of the connecting member has an upper weighing pan 35 rigidly connected thereto with its lower surface engaging such raised portion by any suitable means, such as screws 36.

The load transmitting member 32 has a pin 37 rigidly secured to it, any suitable means by such as welding, at its lower portion and on the vertical center line of its web, so that pin 37 protrudes inwards at right angles to the web of the load transmitting member 32 for a considerable distance.

Fixedly secured to the upper surface of the horizontal arm of the L-shaped bracket 23 by any suitable means, such as screws 38, is a body of load cell 39 made of a suitable metal having generally a plate like shape. The body of load cell 39 has further a narrow section at its mid-portion in symmetry with its longitudinal axis, as shown in FIG. 7, in order that it uniformly deforms upon application of a load at its free end.

The free end of the body of load cell 39 is somewhat bent upward so that there is formed a knife edge 40 having a sharp angle at its upper end and one or more screw holes 41 provided near the free end of the body, and somewhat rearwardly of the knife edge 40. One or more wires 42, each having a small outer diameter, are rigidly fixed at both ends to the free end of the body of load cell 39 by screws 43 screwed in the screw holes 41 and they are reeved across the edge of the knife edge 40 so that the wires 42 are suspended from it, as shown in FIG. 9, and their midportions are wound around the pin 37 secured to the web of the load transmitting member 32, so that this member is held by the wires 42 so that the webs of the supports 28, 29 extend substantially horizontally in parallel with the upper surface of the base 20.

The body of load cell 39 has strain gauges 44 fixedly secured thereto at its upper and lower surfaces by any suitable means such as adhesives in the manner known in the art.

Having thus described the elements comprising a preferred embodiment of a scale according to the present invention, its operation will now be briefly described. When a load is placed on the upper weighing pan 35, the load transmitting member 32 is urged downwards so that it swings about the shafts 25, 26 in parallel with the web of the upright 21 due to the parallelogram construction of the load transmitting member 32, supports 28, 29 and the upright 21 by the shafts 25, 26, 30, 31, whereby the wires 42 are stressed so that the body 38 of the load cell is deformed by its subjection to the force applied to it at the knife edge 40 through the wires 42. The deformation of the body of the load cell 39, corresponding to the magnitude of the load, causes the strain gauges 44 to be strained so that the load applied is converted into a corresponding electrical output.

As the result of experiments, it was found that satisfactory results were obtained when material of constant elasticity, such as that comprising 42 percent of nickel, 5 percent of chromium, 25 percent of titanium, 0.3 percent of aluminium, balance iron with small amounts of manganese, silicon and boron was used as the material for the body of the load cell 39, and when strand wires of stainless steel having the dimension of (7 × 7) were used as the wires 42. Further a knife edge having the configuration as detailed in FIG. 9 gave satisfactory results.

What is claimed is:

1. A balance, using a beam type load cell as a weighing element, comprising, in combination, a substantially flat horizontally oriented base; an upright secured to said base at one end and extending perpendicularly upwardly from said base; a pair of first shafts rotatably mounted in said upright in vertically spaced relation to each other; upper and lower supports each secured at one end to a respective one of said first shafts and extending substantially horizontally therefrom; a pair of second shafts each secured in the opposite end of a re-

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spective support; a load transmitting member mounted on said second shafts to extend substantially parallel to said upright; a weighing pan secured to the upper end of said load transmitting member; a stationary member secured to said upright intermediate said first shafts; a relatively elongated plate form body secured at one end to said stationary member to extend horizontally therefrom, and having a free outer end; a knife edge extending transversely of the free end of said body; at least one strain gauge secured to said body intermediate its ends to measure strain in said body; at least one wire extending across said knife edge and secured to said load transmitting member adjacent the lower one of said second shafts; and means securing the opposite end of each wire to said body inwardly of said knife edge.

2. A balance, as claimed in claim 1, in which said upright has a channel-like cross section with its web extending vertically, said first shafts being journaled in the flanges of said upright in vertical alignment with each other.

3. A balance, as claimed in claim 2, wherein said sup-

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ports have a channel-like cross section; said second shafts each extending through the flanges of a respective one of said supports and being vertically aligned with each other; the vertical spacing of said second shafts being substantially equal to that of said first shafts.

4. A balance, as claimed in claim 3, in which said load transmitting member has a channel-like cross section; said second shafts being journaled in the flanges of said load transmitting member.

5. A balance, as claimed in claim 4, including a pin secured to the web of said load transmitting member adjacent the lower one of said second shafts, and extending inwardly from said web toward said upright; at least a pair of wires looped around said pin and extending across said knife edge; said securing means securing the opposite ends of each wire to said body inwardly of said knife edge.

6. A balance, as claimed in claim 5, in which said knife edge is formed integrally with said body.

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