

A WEIGHING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the invention

This invention relates to a weighing apparatus of the type which is for weighing loads and which can be used in either of two modes, namely as a stationary weighing apparatus wherein the apparatus rests on a support surface and the load rests on the apparatus, or as a hanging weighing apparatus wherein the apparatus hangs from a support, and the load hangs from the apparatus.

The same measuring means measures the load regardless of the mode of use and the direction of application of the load is the same regardless of the mode of use.

Such weighing apparatus will be referred to hereinafter and in the appended claims as "weighing apparatus of the type set forth".

The weighing apparatus, to which the invention relates is particularly suitable for weighing and pricing of goods purchased in a shop such as a supermarket and wherein the measuring means comprises a strain gauge with a mathematics-logic circuit and a display.

2. Description of the Prior Art

In the provisional publication of Japanese Utility model No. Sho 58-180423, there is disclosed a weighing apparatus of the type set forth comprising an upper loading plate and a lower

receiving plate which co-operate with a free end of a strain gauge (or so-called load-cell), and wherein the preferred plate is selected according to the shape, size and use of the goods to be weighed, whereby it is possible to weigh various types of goods. However, this conventional type of weighing apparatus is used by fixing the weighing portion consisting of the load-cell to a table or desk in a shop through a fixing metallic part such as a hanging hook and the like, and its utility is limited. Thus, it cannot simply be converted into a hanging type weighing apparatus from a stationary type weighing apparatus and its portability is limited.

Known forms of weighing apparatus of the type set forth are described in British Patent Nos. 1,496,389 and 599,156, but in each of these apparatus the loading on the measuring means is the same regardless of whether the apparatus operates as a hanging type weighing apparatus or a stationary weighing type apparatus. In the case of the apparatus of each of these British Patents the measuring means is a spring operated scale mechanism which is put under compression when the load is applied, in either mode.

It is an object of the present invention to provide a weighing apparatus having a highly wide use which is capable of converting either to a hanging type or stationary type by means of simple re-arrangement of the structure and which uses a load-cell as the measuring means which is stressed oppositely when measuring in the respective weighing modes.

SUMMARY OF THE INVENTION

According to the present invention there is provided a weighing apparatus of the type set forth, said apparatus having a load-cell means for measuring the weight of a load

on the apparatus, characterised in that the load-cell is an elongate member lying transverse to the direction of application of the load, and the respective ends thereof are anchored to respective parts of the apparatus, said parts being a case body and a fixing member, between which parts the load is applied in each mode of use of the apparatus.

The weighing apparatus according to the present invention can be used as a hanging type weighing apparatus or a stationary type weighing apparatus from the above hanging type and it requires only relatively simple fixtures for its conversion from one mode to the other.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described by way of example, with reference to the accompanying drawings, wherein:-

Figs. 1 and 2 show a first practical example of a weighing apparatus or the type set forth and according to the invention, Fig. 1 being a sectional view of the apparatus when used as a hanging type weighing apparatus, and Fig. 2 being a sectional view of the apparatus when used as a stationary type weighing apparatus;

Fig. 3 is a circuit diagram for explaining the means of switching of the polarity of the output of the load-cell forming the measuring means of the apparatus of the invention;

Fig. 4 is a graphical representation showing another means of switching the polarity of the output of a load-cell;

Figs. 5 and 6 are views similar to Figs. 1 and 2 and show a second practical example, Fig. 5 being a sectional view of a hanging type weighing apparatus and Fig. 6 being a sectional view of a stationary type weighing apparatus;

Figs. 7 and 8 are views similar to Figs. 5 and 6, but show a modified construction; and

Figs. 9 to 14 show a third practical example, Fig. 9 being a sectional front view of the apparatus used as a hanging type weighing apparatus, Fig. 10 being a sectional side view of part of the weighing apparatus of Fig. 9, Fig. 11 being a perspective illustration of the apparatus, Fig. 12 being a sectional front view of the apparatus when used as a stationary type weighing apparatus, Fig. 13 being a sectional side view of the apparatus of Fig. 12 and Fig. 14 being a perspective illustration of the apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in detail to a preferred embodiment of the present invention as shown in Figs. 1 and 2 of the drawings, in Fig. 1, the apparatus shown has a case body (1) consisting of an upper case (1a) in the form of an inverted cup and a lower case (1b) in the form of a flat plate attached with the bottom surface of the upper case (1a), and a load-cell (2).

A rod hole (3) is provided on the ceiling of the upper case (1a) and a hanging rod (4) passes therethrough. A plate hanger (5), which is a rod (5) with a scale plate (5a) is secured to the center portion of the bottom surface of the lower case (1b) by means of a screw fixing.

Four nuts (6)(6) are fixed by welding on the upper surface

and at the four corners of lower case (1b) and four openings are provided in the lower case (1b) in register with the four nuts (6) to enable threaded feet to be screwed thereinto.

In Fig. 1, the load-cell (2) elongate as shown and is arranged within the case body (1), so that one end is fixed at (7) to the lower case (1b) at the upper surface thereof the other end is fixed to fixing member (8) which is in turn connected to rod (4).

The fixing member (8) lies parallel to the upper surface of load-cell (2) and the lower end of hanging rod (4) is detachably connected to the end portion of fixing member (8) by means for example of a screw connection which may be by pre-formed mating threads or by a self tapping arrangement. The hanging rod (4) projects from the upper case (1a) as it passes through the rod hole (3) as described.

In the Fig. 1 mode, the upper end of hanging rod (4) is secured to a ceiling surface (9), and the apparatus is a hanging type weighing. In this case, the fixing member (8) acts as a reactive support of the load on the load-cell (2) and the connection (7) functions as a direct application point of the load on the load-cell.

Fig. 2 shows the weighing apparatus of Fig. 1 when used as a stationary type. This is achieved by removing the hanging rod (4) from the fixing member (8), and then fixing instead a scale plate unit comprising supporting bar (10), and scale plate (11) for receiving the load, as shown. Also hanger (5) is removed and four screwed feet (12) are threaded into the nuts (6)(6) by their threaded stems (12a), by which feet the apparatus can stand on a flat support surface. The supporting fee (12) can be adjusted to keep the apparatus level.

In Fig. 2 therefore, the weighing apparatus becomes a stationary type, and the fixing member (8) acts direct for loading point for the load-cell and the location (7) functions as a reaction support.

As will be understood from the above, the load-cell is stressed in opposite directions between the hanging mode in Fig. 1 and the stationary mode in Fig. 2, and as a result the weighing stress changes between the modes from positive to negative. Accordingly, to give correct readings it is necessary to convert the polarity of the output circuit of the load-cell.

To convert the polarity, there are various methods such as that shown in Fig. 3, where the polarity of the input circuit of a Wheatstone bridge (13) in the load-cell is changed by means of the operation of switch (14). It is possible to indicate output value by means of an absolute value as shown in Fig. 4, or it is possible to indicate a value wherein the polarity is changed by multiplying an output value by a negative value. (These methods are applicable in the following practical examples)

Fig. 5 and Fig. 6 show the second practical example of the present invention. In Fig. 5, a case body (21) is similar to the case body (1). The case body (21) consists of an upper case (21a), a lower case (21b) and four threaded bores (22)(22) which are provided in the four corners of the lower case (21b) for receiving support feet.

The load-cell (23) is connected at one end and at its upper side to the upper case (21a) by a strap (24), and a fixing member (25) is connected to the other end of the upper surface of the load-cell (23) and lies parallel with the

upper surface of the load-cell (23). A hanging rod (26) is detachably connected to the end of fixing member (25) as shown.

The hanging rod (26) is arranged to project from the upper case (21a) through a rod hole (27) of the case body (21). A ring (26a) is provided at the end of hanging rod (26) to enable the case body (21) to be hung from a support (28) by engaging the ring (26a) on a hook (28a) fixed on the support (28).

A hanger (29) comprises a rod (29) and a weighing plate (29a) is detachably fixed to the bottom surface of lower case (21b).

In Fig. 5, the fixing member (25) forms the reactive support for the load-cell (23) in relation to a load carried on plate (29a) and the fixing member (24) forms the direct load application point for the load-cell.

In order to convert the apparatus into a stationary type, the hanging rod (26) is removed from the fixing member (25), and a plate receiving bar (10') having a weighing plate (11') at the upper end is connected thereto as shown in Fig. 6. Also, plate hanging rod (29) is removed from the lower case (21b) and threaded stems (30a) of supporting feet (30) are screwed into the female bores (22)(22) also as shown in Fig. 6.

Figs. 7 and 8 show a modified example of the apparatus of Figs. 5 and 6. In Fig. 7, the case body (21') also consists of an upper case (21'a) and a lower case (21'b), similar to case body (21) in the structure of the upper and lower cases, but additionally there are support rods (31)(31) which connect the ceiling of upper case (21'a) and the lower case (21'b) at their four corners. Four small holes (32)(32) are

bored onto the bottom floor of the lower case (21'b) so as to register with the supporting rods (31) and the diameter of each of the small holes (32) is slightly smaller than the diameter of each of the supporting rods (31). In the hanging mode, as shown in Fig. 7, a female screw is bored into the lower end of supporting rod (31) and these screws have hooks (33), whereby a plate hanging member (29') having a weighing plate (29'a) can be suspended by the hooks (33). The hanging member (29') may be a wire, a string, a chain and the like.

The load-cell is designated with the same reference numeral (23), as it is similar in construction and function to that described in relation to Fig. 5.

In Fig. 7, the hanging rod (26') is mounted by fixing the upper end of the hanging rod (26') to the ceiling (28') and the lower end of hanging rod (26') is fixed detachably with the fixing member (25) through a rod hole (27'). As an alternative option, the hanging rod (26) of Fig. 5, with the hook and eye arrangement, may be used instead of the hanging rod (26'). In addition, it is recommended that when a hanging rod and a hanger are installed, it is better to install them with a shock absorbing structure because it is preferable to protect the load-cell from any shock that may be applied on the case body and its weighing plate when they are used.

In the use of the apparatus of Fig. 7, the fixing member (25) acts as the reactive support for the load-cell (23) when plate (29'a) carries a load and the fixing (24) functions as the direct load application point, which is similar the arrangement of Fig. 5.

To convert the Fig. 7 arrangement to the other mode of operation, the hanging rod (26') is removed from the above

fixing member (25) and instead there is connected thereto a plate receiving bar (10") having a weighing pan or plate (11"). Also, the hanging metallic part (33) is removed from the supporting rods (31) of lower case (21'b) and in place of same threaded stems of a supporting feet (30') are threaded into the threaded ends (32) of rods (31) the apparatus is thus converted to a stationary type weighing apparatus, quickly and readily as shown in Fig. 8.

According to this modification, the case body (21') is reinforced by means of the supporting rods (31)(31) within the case body (21'). In addition, the same fillings enable the mounting of the hanging metallic parts (33) and the supporting feet (30'), simplifying production.

The examples of the invention previously described have been illustrated diagrammatically. Figs. 9 to 14 show a more practical embodiment. In Figs. 9 and 10, the case body (40) consists of a case (40a) comprising a deep, hollow inverted cup which is made of ABS-resin (alkyl benzen sulonate resin) and the like which is open at the bottom, a case cover (40b) provided to cover but not connected to the upper portion of the hollow ware shaped case (40a), and a bottom cover (40c), closing the open end of case (40). Arranged within the case body (40) is a load-cell (41) and under the load-cell (41) is a housing space in which is housed various parts namely batteries (42)(42'), an A/D [analog/digital] convertor circuit (43), a display circuit (44) and a mathematics-logical substrate (45) which is incorporated with the display circuit (44).

Display indicators (46a)(46b)(46c) and (46'a)(46'b)(46'c) are arranged at two side of the case body (40) so as to be viewable through apertures (46a)(46b)(46c), (46'a)(46'b)(46'c) in the case (40a). (Fig. 11 and Fig. 14)

As shown in Fig. 9, longitudinal supporting members (47)(47') extend downwardly in the interior of the upper portion of case (40a) along two side walls, and both the lower ends of longitudinal supporting members (47)(47') are fixed to lower ends of a fixing member (48) of inverted U-shape. The load-cell (41) is secured to the U-shaped fixing member (48) via the bottom surface of one end of the load-cell (41) to the U-shaped fixing member (48) by a spacer (49), and one end of a fixing member (50) is fixed on the upper surface of load-cell (41) at the other end thereof.

The above fixing member (50) is C-shaped in cross section and the load-cell (41) locates between its sides with clearance.

The case cover (40b) has a shape to enable it to cover and overlap the head of the case (40a). A fixing section (51) thereof is provided to lie centrally of case cover (40b) and a threaded bore (51a) is formed at the center portion. Boss sections (52) which lie to opposite sides of bore (51a) to project downwards from the cover underside and these boss sections (52) are made to pass through the ceiling portion of case (40a) and are connected to the C-shaped fixing member (50) by means of self-tapping screws (53). Fixing section (51) projects upwardly of the upper surface of case cover (40c) and a concave recess (51b) is formed in upper surface of the section (51). A vertical hanging rod (54) is removably connected to the case cover (40b) in that a threaded end (54a) of the hanging rod (54) is threaded into the bore (51a), the hanging rod (54) also having a ring (54b) to engage a hook (55a) fixed to a support ceiling (55) by which the apparatus can be suspended for use in the hanging mode.

The hanging rod (54) is thus arranged to connect with the

fixing member (50) of load-cell (41) through the case cover (40b), hanging rod holes being provided on the head of case (40a) for this purpose. The cover (40b) covers these holes and the load-cell (41) and other electronic parts are therefore protected from ingress of a foreign matter.

A battery case (56) is connected to the supporting members (47)(47') and the fixing member (48). The battery case (56) comprises of two battery containing portions (56b)(56'b) which are located on the left and right sides and of the case (40a) is shown in Fig. 9 the A/D circuit (43) is fixed to a containing frame (56a) which is part of the battery case and which lies between the portions (56b)(56'b).

The battery containing portions (56b)(56'b) are formed to be of cylindrical shape and each is open at the bottom. The lower end of the opening each of the battery containing portions is positioned approximately at same level as the lower end of the case (40a). The batteries (42)(42') are loaded from said lower end. Respective substrate supporters (57)...., (57')... are provided to project from on both sides of the battery case (56)(56') and the display circuit (44) is fixed on the substrate supporter (57) and the mathematics-logic circuit (45) is fixed on the substrate supporter (57'), fixing being by tapping screws.

As shown in Fig. 10, display circuit (44) has display sections (58a)(58b)(58c) arranged in registry with the display windows (46a)(46b)(46c).

Likewise, the mathematics-logic circuit (45) has its display sections (58'a)(58'b)(58'c) arranged in registry with the display windows (46'a)(46'b)(46'c).

The display sections (58a)(58'a) indicate the weight of the

goods being weighed, the display sections (58b)(58'b) indicate the unit price of the goods and the display sections (58c)(58'c) indicate the total price of the goods.

The battery case (56) has a central fixing section (59) at the bottom thereof, which section (59) has a center screw hole (59a) and two side screw holes (59b)(59'b) in the bottom thereof and the bottom cover (40c) is removably fixed to the fixing surface (59) by screwing tapping screws (60)(60') into the side screw holes (59b)(59'b).

An aperture (61) is provided at the center portion of bottom cover (40c) so as to expose the screw hole (59a) and a hanging hook (63) of a weighing plate is threaded into the passage hole (61).

Loading of batteries (42)(42') is performed by initially loading a predetermined number of batteries (42)(42') in to elongated guide plates (62)(62') integral with the bottom cover (40c) and then the guide plates (62)(62') together with the batteries (42)(42') are loaded into the battery containing portions (56b)(56'b) and finally the bottom cover (40c) is secured to the case (40a) by the two screws (60)(60'). A hanger comprising hanging chains and a weighing plate (64a) is engaged with the hanging hook (63) to hang the weighing plate (64a) from the case body (40).

Also shown in Fig. 10, wireless receiving sensors (65) adapted to receive wireless signals from an operating transmitter (70) (Fig. 11) located remotely from the case body (40) are carried by display circuit (44) and mathematics-logic circuit (45) and a member (66) which is adapted to actuate the switch (14) for converting the polarity as described in Fig. 3 is carried by circuit (45).

A stopper (67) (Fig. 9) is provided to restrict and protect the load-cell (41) from an excessive load when an excessive load is applied the weighing plate (64a).

Packing material (69) is provided around the periphery of bottom edge.

In using the apparatus in the hanging mode of Figs. 9 and 10 the fixing member (50) provided on the load-cell (41) provides the reactive support for load-cell (41) through the case cover (40b) and the hanging rod (54) and the load on the weighing plate (64a) is transmitted directly to the fixing member (48) and load-cell through case (40a), the supporting member (47)(47'), the fixing member (48) and the battery case (56).

Fig. 11 shows a perspective illustration of the apparatus when used as a hanging type weighing apparatus. In Fig. 11, the operational transmitter (70) is provided with an input means such as a ten-keys, enabling the dispatch of the necessary information to the wireless receiving apparatus (65) housed in the case body (40).

Figs. 12 and 13 show the apparatus of Figs. 9 and 10 when converted from the hanging type into the stationary type. The hanging rod (54) has been removed from the screw hole (51a) of case cover (40b) and in its place has been connected a weighing plate (72) by means of a weighing plate receiving plate (71) on the case cover (40b). On the other hand, the plate hanging hook (63), the screws (60)(60') and cover plate (40c) have been removed from the fixing surface (59) of battery case (56), and these are replaced utilizing the fixing surface (59), by an installation base (73) with supporting feet (74) as shown .

The weighing plate receiving plate (71) consists of two sheet plate members which are overlapped and connected by welding so as to have an almost identical shape to that of the bottom surface of weighing plate (72) and the lower plate member, (71) has a mounting which fits into recess (51b) of the fixing section (51). Its center portion has a threaded stud (75) which engages the screw hole (51a) of fixing section (51) to fix it detachably on the case cover (40b). The weighing plate (72) may be spaced from the base plate (71) at its edge by a rubber packing material (76) attached on the upper surface at the periphery of the weighing plate receiving plate (71).

This installation base (73) has a flat upper face (73a) which substitutes for the bottom cover (40c) and includes with an outer periphery section having a larger area than the case body (40), and a concave shaped storing portion (73b) on the front portion of the installation base (73) for storing the operational transmitter (70).

Supporting rods (77) formed with a threaded holes are arranged at the four corners in the installation base (73) and a threaded stems (74a) of the supporting feet (74) are threaded into the supporting rods (77) for supporting, levelling and adjusting the height of installation base (73).

The bottom cover (40c) is disconnected from the case body (40) by unscrewing the screws (78)(78') and the installation base (73) is connected to the case body (40) by the same screws (78)(78'). In this practical example, the fixing section of the supporting feet includes the supporting rods (77) formed in the installation base (73).

In Fig. 12, references (81)(81') indicate battery guide rods which project upwardly from the upper surface (73a) of

installation base (73). In Fig. 13, the reference (79) shows the batteries of the operational transmitter (70).

In use of the apparatus in the stationary mode is shown in Fig. 12 and Fig. 13, the fixing member (50) becomes a direct load transmitting member for the load-cell and the fixing member (48) provides the reactive support. In this practical example, dust is prevented from coming into the interior of case body since the case body (40) does not have any hole connecting the interior and exterior of the case body (40).

Fig. 14 shows in perspective view the apparatus when used as a stationary type weighing apparatus. Reference (80) shows a spirit level which is needed when adjusting the height of the supporting feet (74).

In the above practical example, the electronic equipment and display means such as display circuit (44), the mathematical circuit (45), the A/D circuit (43), the batteries (42)(42') and the like have been described in more detail but in all embodiments, the above electronic equipment and display means will be provided as necessary.

According to the installing position of load-cell in the upper case, the electronic equipment is also in the upper case. This facilitates the installation of the weighing apparatus. In the Figs. 9 to 14 example, the supporting feet (74) are fixed with the installation base (73) but as shown in the other examples, the supporting feet (74) may be fixed initially to the bottom cover (40c).

According to the present invention, a weighing apparatus of the type set forth can be converted from a hanging type to a stationary type by converting a simple change of fittings. Therefore, it can provide a wide use type of weighing

apparatus, and at the same time the mass production efficiency of the apparatus is improved, reducing production costs, because there is change of the weighing body structure.

Modifications may be made in practicing the invention. Accordingly it is not intended to have the invention limited to or circumscribed by the specific details of procedure, materials, proportions herein above set forth by way of example, in view of the fact that the invention is susceptible to modifications according to individual preference or conditions without departing from the scope of the appended claims.



CLAIMS

1. A weighing apparatus of the type set forth, said apparatus having a load-cell means for measuring the weight of a load on the apparatus, characterised in that the load-cell is an elongate member lying transverse to the direction of application of the load, and the respective ends thereof are anchored to respective parts of the apparatus, said parts being a case body and a fixing member, between which parts the load is applied in each mode of use of the apparatus.
2. A weighing apparatus according to claim 1, wherein said case body is provided with a detachable weighing plate hanging member and a weighing plate for the weighing of articles by suspending the apparatus from a suspension support.
3. A weighing apparatus according to claim 1, wherein said case body is provided with detachable supporting feet for the weighing of articles by resting the feet on a support surface.
4. A weighing apparatus according to claim 3, wherein the fixing member has a weighing plate receiving member having a weighing plate on the upper end of said weighing plate receiving member.
5. A weighing apparatus according to any preceding claim, wherein said case body consists of an upper case and a lower case and said load-cell is fixed by its lower edge of said one end to said lower case, and said fixing member is fixed on the upper edge of the other end of said load-cell.
6. A weighing apparatus according to any of claims 1 to 4, wherein said case body consists of an upper case and a lower



case, and said load-cell is fixed by its upper edge of said one end of the load-cell to the inside upper wall of said upper case, and said fixing member is fixed on the upper edge of the other end of said load-cell.

7. A weighing apparatus according to claim 6, wherein supporting rods which pass through the inside of the body are provided to connect the upper case and said lower case at four corners of said case body, and holes open at the bottom of said lower case are provided to register with said supporting rods, and female screws are provided at the ends of said supporting rods, to constitute fixing sections for a weighing plate.

8. A weighing apparatus according to claim 1, including in the case body under the load-cell a battery, a display circuit and two display columns for indicating the weight and cost of the articles provided at each of a pair of walls of said case.

9. A weighing apparatus according to claim 8, wherein said case has an opening in the bottom surface of case body, and the case body comprises a case cover and a bottom cover, said fixing member being connected with said case cover, and including a fixing section formed in the center portion of said case cover, and said bottom cover has a female screw connection centrally thereof.

10. A weighing apparatus according to claim 9, wherein the case body comprises two battery receiving sections arranged at opposite sides of said case, each said battery receiving section being cylindrical and having an opening at the bottom and including a plurality of guide plates, integral with said bottom cover and which project upwardly into the battery receiving section, so that it is possible to insert said



guide plates together with batteries into said battery containing sections.

11. A weighing apparatus according to claim 8, including an operational transmitter including a key board with function keys, and a receiver arranged in said case body to receive said signals from said transmitter for operating the weighing apparatus.

12. A weighing apparatus according to claims 8, 9, 10 or 11 including an installation base having supporting feet and adapted to be fixed to the bottom cover of the case body when the apparatus is to be used as a stationary weighing apparatus.

13. A weighing apparatus according to claim 12, when taken with claim 11, wherein said installation base provides a storing section to removably house said operational transmitter.

14. A weighing apparatus according to any preceding claim, including a switching means for switching the output polarity of said load-cell according to whether it is used as a hanging type or stationary type weighing apparatus.

15. A weighing apparatus according to claim 14, wherein said switching means consist of a switching means in which the input polarity of a Wheatstone bridge circuit of said load-cell is switched by a switching operation.

16. A weighing apparatus according to any embodiment as set forth and described in the specification and illustrated in the drawings.
