Oct. 18, 1960 W. J. OPOCENSKY 2,956,437

SWITCH ACTUATOR FOR COUNTER

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FIG. 1

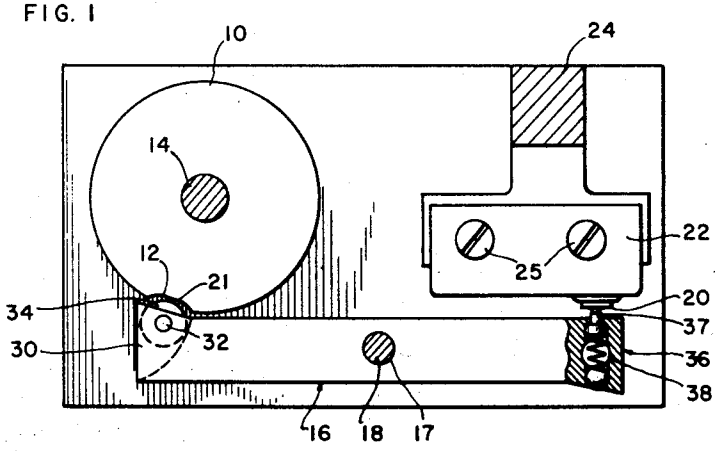
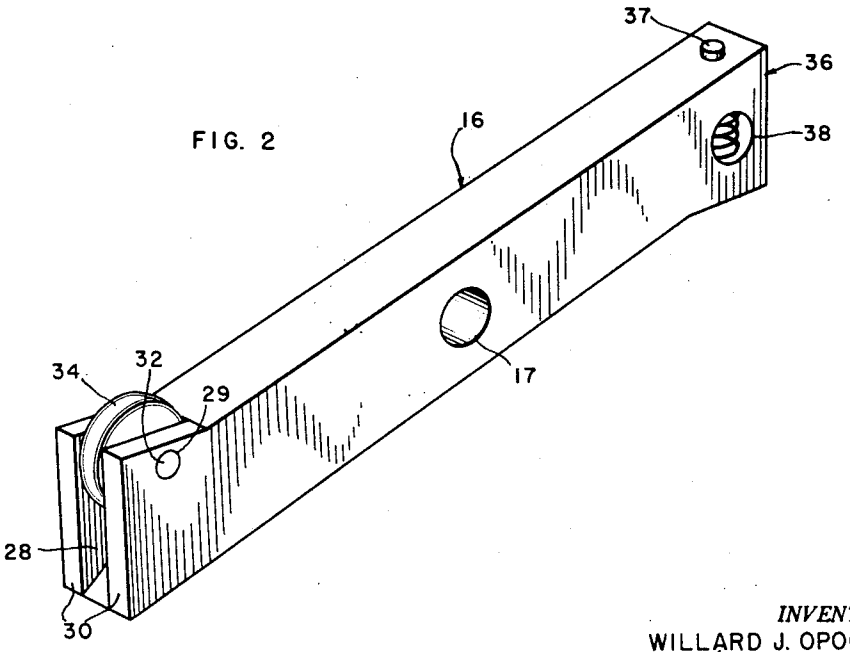


FIG. 2



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FIG. 6

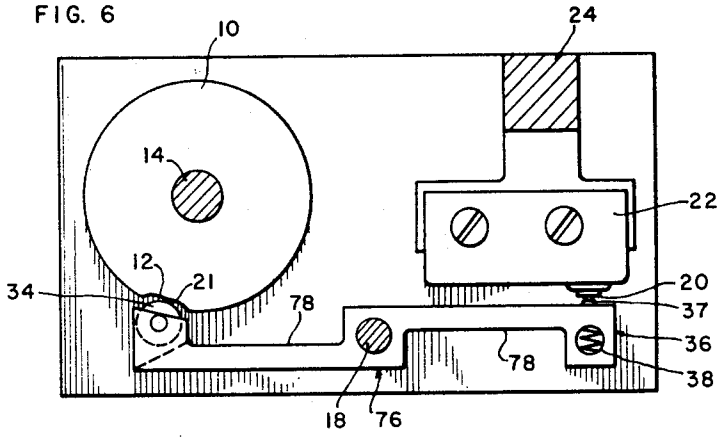


FIG. 3

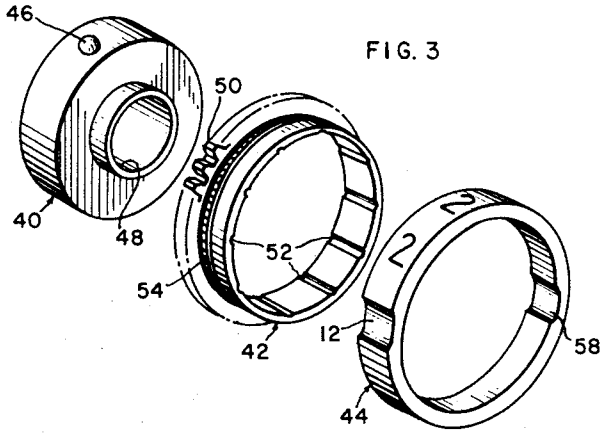
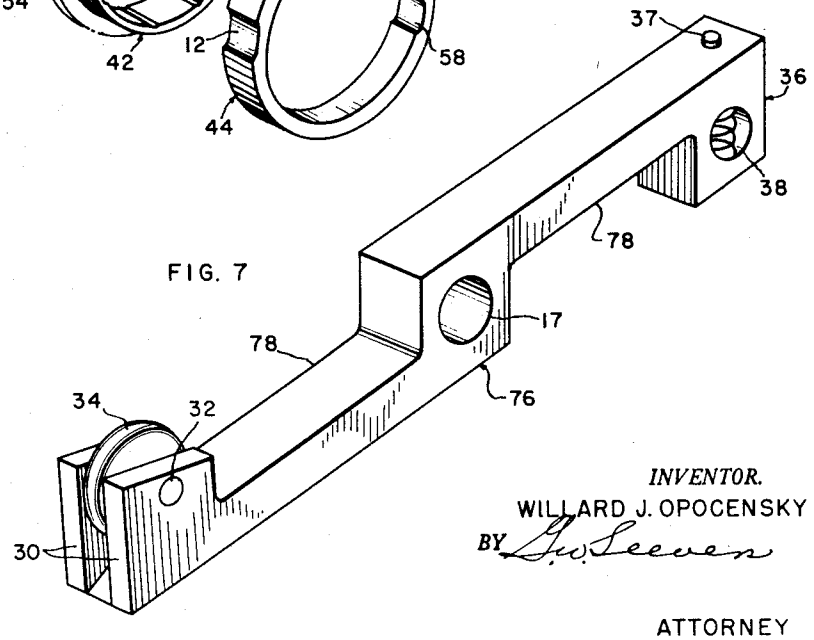


FIG. 7



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FIG. 5

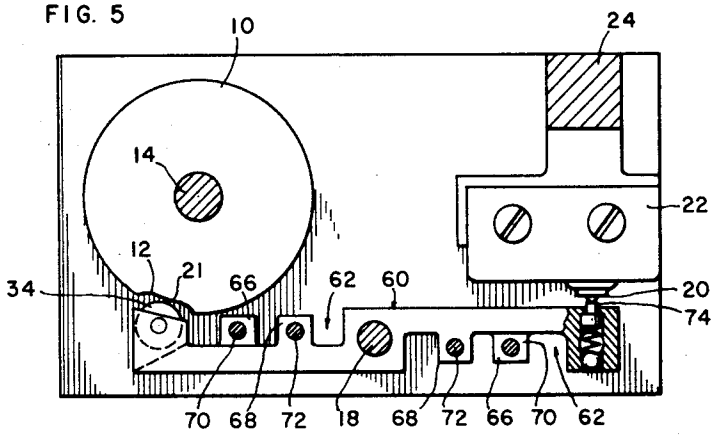
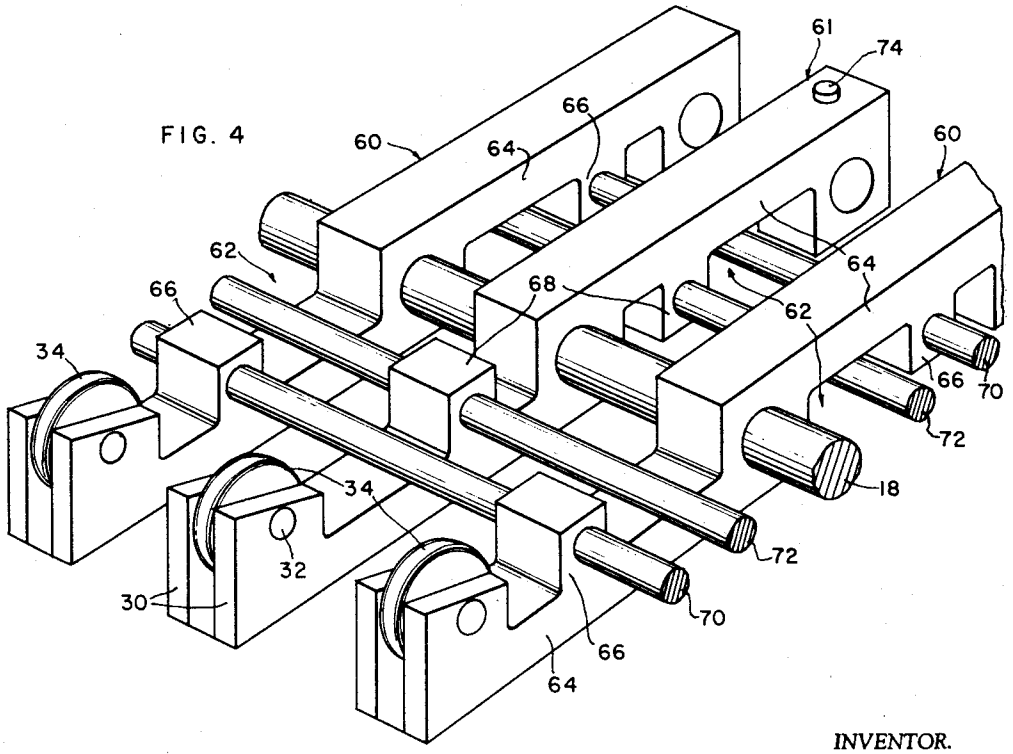


FIG. 4



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2,956,437

SWITCH ACTUATOR FOR COUNTER

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Filed July 9, 1957, Ser. No. 670,695

11 Claims. (Cl. 74—54)

This invention relates to a new and improved switch actuator for a counter, and more particularly to an improvement in a microswitch actuating mechanism.

Briefly described, my switch actuator is provided with a lever which is so constructed that it is pivoted about an axis extending through the mass center of the length of said lever. Said lever is of such a mass and balance throughout that it is neutral to vibrations of a frequency below those encountered in the normal operation of the counter. A balanced actuating cam wheel is also provided and is associated with the lever in such a manner that vibrations set up in the counter proper to the arm and microswitch are reduced to a minimum.

Counters applied to the operation of high velocity vehicles are subject to vibrations that upset the normal operation of such counters causing them to malfunction, giving false readings. One of the causes of this malfunction are vibrations created from outside the counter setting up natural vibrations which are sensed in the actuating mechanism of the microswitch of said counter.

It has been found that malfunction in these counters was primarily due to large amplitude shock and to oscillations set up in the micro switch actuating lever, and were particularly objectionable in the lower ranges approximately from 0 to 1000 cycles per second. These oscillations cause a false movement of the actuating lever which would trip the micro switch giving a false count. Such false count would relay incorrect information to the control devices connected to the micro switch.

Attempts to solve this problem in other counters have been made by use of external damping means which effectuate a neutralization of the vibrations after they are set up in the actuating mechanism. These have been only partially successful, but are primarily objectionable because the damping means tends to add weight and mass to the counter which is unacceptable for devices of this type. The damping means may also introduce other oscillations of their own.

One of the objects of this invention is to provide a counter that will not be influenced by exterior forces such as vibration, shock and linear acceleration.

A further object of this invention is to provide a counter with a micro switch actuating lever that is dynamically neutral.

Another object of this invention is to make the switch actuating mechanism insensitive to normally encountered external vibrations and at the same time eliminate the use of external damping means.

It is a further object of this invention to provide a counter with cam wheels so constructed that there will be no oscillations transmitted from the cam wheels to the switch actuating mechanism.

A further object of this invention is to provide a flexible connection between the actuating lever and its associated microswitch to absorb normal operational oscillations of the actuating lever, transmitted from counter cam wheels, preventing such oscillations from causing damage to said micro switches.

A still further object of this invention is to provide a counter having cam wheels and their associated actuating levers in spaced relation to each other so that normal operational oscillation of the cam wheels will not be transmitted to the actuating lever.

Other objects and advantages of this invention will become apparent as the discussion proceeds and when taken in connection with the accompanying claims and drawings, in which:

Figure 1 shows a sectional view of the micro switch actuator mechanism embodying this invention;

Figure 2 shows a perspective view of the actuating lever;

Figure 3 shows an exploded view of a cam actuator wheel;

Figure 4 shows a perspective view of a modified form of actuating lever embodying this invention, adaptable for use where the levers are ganged;

Figure 5 is a sectional view showing a modified microswitch actuator mechanism employing the ganged arms shown in Figure 4;

Figure 6 is a sectional view of a micro switch actuator mechanism showing another modification of the actuator lever;

Figure 7 is a perspective view showing a single modified actuator lever shown in Figure 6.

Referring now to a detailed description of the drawings, in Figures 1 and 2, the numeral **10** designates a cam wheel **1** having a detent **12**. Cam wheel **10** is supported on a counter shaft **14**. Actuating lever **16** is pivotally supported on a fulcrum shaft **18**. The lever **16** transmits motion from the cam wheel **10** to a micro switch actuating plunger **20** which operates a suitable micro switch **22**, the details of which form no part of this invention and are not shown. The micro switch **22** is rigidly mounted on a frame support member **24** by screws **25**. Counter shaft **14**, fulcrum shaft **18** and frame support member **24** are mounted on a suitable frame.

Actuating operating lever **16**, as shown in Figure 1 and 2, is rectangular in cross section and is provided with a hole **17** which is geometrically located at the fulcrum point on shaft **18**. One end of the lever **16** is slotted, as shown at **28**, forming a pair of ears **30**. A pin **32** is press fitted through a pair of holes **29**, in the ears **30**, and rotatably supports a cam follower roller **34** which is laterally confined between the ears **30**, and is adapted to engage the cam **10** as shown in Figure 1. The opposite end of the lever **16**, designated by the numeral **36**, is provided with a spring pressed plunger **37** adapted to engage the actuating plunger **20** of micro switch **22**. The end **36** of lever **16** is also provided with a hole **38** to dynamically balance the lever by compensating for the slot **28**.

The lever **16** is balanced in regard to its pivot or fulcrum point. This fulcrum point is in the center of gravity of the arm and is also located at the geometrical center which makes the operating lever statically balanced and dynamically neutral. For purposes of definition, dynamically insensitive to vibrations about its axis which may occur during normal operation of the counter in this particular application means the body of the operating lever is pivotally supported through the center of gravity and expresses no net moments under linear acceleration or excitation below acceptable limits.

The spring pressed plunger **37** provides a flexible connection between the arm **16** and micro switch actuating plunger **20**, so that when the micro switch is in an activated position, with the roller **34** engaging the outer periphery of cam wheel **10** and plunger **37** is holding plunger **20** in a depressed position, any normal oscillations of the cam **10** that would exceed the designed over-

travel of micro switch would be absorbed by the plunger **37** preventing these normal oscillations from being transmitted into the micro switch and causing damage thereto.

It will be noted by the foregoing description that an actuating lever is constructed with proportion and material for rigidity and low mass that provides a member having the desired characteristics.

In the operation of the counter the roller **34** normally engages the outer periphery of the cam wheel **10** which rocks the lever **16** in a counterclockwise direction, as viewed in Figure 1. This motion depresses the actuating plunger **20** of micro switch **22**. When the cam wheel **10** rotates to the position shown in Figure 1, i.e., the cam detent **12** is adjacent the roller **34**, the lever arm is allowed to rock in a clockwise direction, as viewed from the drawings, releasing the micro switch actuating plunger **20**. (It is important at this point to observe that in this position there is a slight space **21** between the roller **34** and cam detent **12** in cam wheel **10**.) This space is important to the fact that when the counter is subjected to very intensive external vibration, the counter shaft **14** would tend to respond and cause the cams **10** to vibrate, which in turn would act against the roller **34** of lever **16**. If they were in contact this would then cause actuation of plunger **20**. The space **21** in effect permits minor movement of cam **10** without actuation of plunger **20** and is an added dampening factor which overcomes or compensates for minor vibrations, as well as random movements which may be transmitted through arm **16**.

Figure 3 is a detailed view of the actuating cam wheel and is comprised of three major parts—a hub portion **40**, an intermediate rim and gear portion **42**, and an outer cam ring **44**. The hub portion **40** is provided with a pair of diametrically opposed spring pressed ball detents **46**. The hub **40** is also provided with a hole **48** which fits on shaft **14**. The intermediate rim **42** is provided with a gear ring **50** which is adapted to mesh with other mechanisms of the counter which forms no part of the present invention and is not shown. The rim **42** is also provided with an even plurality of grooves **52** which are adapted to co-act with hub ball detents **46** permitting indexing therewith. The rim **42** is also provided with striations **54**. Outer cam ring **44** is provided with an inner periphery that is adapted to slip fit over the outer periphery of the intermediate rim **42**, and force fits over the striations **54** which secures the rim **42** to the cam ring **44**. Notch **12** is provided on the outer periphery of cam ring **44**, as shown in Figures 1 and 3. A notch **58** in the inner periphery of cam ring **44** counterbalances the notch **12**. From the foregoing description, it will be noted that I have provided a cam wheel of balanced design that will introduce no oscillations when the counter is subjected to vibrations and large amplitude shocks.

Referring now to Figures 4 and 5, I have shown modified actuating levers that are so constructed that they are adaptable to be ganged. The counter may be similar in construction to that shown in Figure 1, having cam wheel **10** supported on counter shaft **14**, a micro switch **22** mounted on frame member **24** and a fulcrum shaft **18** which pivotally supports a plurality of actuating levers **60** and **61**. Levers **60** and **61** are of a balanced construction similar in design to lever **16**, with the exception they are relieved as at **62** to provide space for ganging connections. The relief **62** cut from the levers **60** and **61** leaves a comparatively narrow cross section **64**. Projections **66** and **68** extend from the sections **64** of the levers **60** and **61**, respectively. Rods **70** connect the projections **66** and subsequently the levers **60**. Similarly, lever **61** may be connected to other levers of the same arrangement of projections **68** by rods **72**.

The levers **60** and **61** are also provided in a similar manner to lever **16**, with cam follower rollers **34** pivotally supported on ears **30** by pin **32**. The opposing end of lever **61** is provided with a spring pressed plunger **74** which is adapted to engage the micro switch actuating plunger **20** of micro switch **22**. The space **21** exists in the form shown in Figure 5 in the same manner and for the same purpose for that described and shown in Figure 1.

In counters of the type shown in Figures 4 and 5 wherein a plurality of cams **10** and ganged actuating levers **60** and **61** are utilized, a flexible connection between the actuating levers and micro switch actuating plungers is provided for the same purpose, and in the same manner shown for Figure 1. The plunger **37** also compensates for any minor differences of relative position of these members. If one or more of the associated cam wheels were rotated to the position wherein the outer periphery engaged the cam rollers **34**, the lever **61** would be rocked in a counterclockwise direction, which would cause the plunger **74** to depress the micro switch plunger **20**. If, for any reason this motion would exceed the over-travel of micro switch **72**, the plunger **74** would yield, allowing complete travel of lever **61** without damage to any of the associated parts. Conversely, if a plurality of switches **22** were utilized, plungers **74** would hold all switches in an activated position, regardless of discrepancies, until all of detents **12** are in alignment with rollers **34**.

It will be seen by reference to the foregoing description and Figures 4 and 5, that I have provided a plurality of ganged actuating levers of a balanced construction that will not be subject to oscillation under normal operational vibrations.

Referring now to Figures 6 and 7, I have shown a still further modified actuating lever **76**. All of the associated parts of the counter are identical in construction and operation to that shown and described in Figures 1 and 2. The actuating lever shown in Figures 6 and 7 differs in respect to that shown in Figures 1 and 2 in that a relieved portion **78** is removed from diametrically opposed areas of the lever **76**. The relieved portion **78** results in a lower mass of lever **76**, which increases the range at which the arm does not respond to vibration.

A brief explanation of my invention is as follows: The actuating levers in all forms are statically and dynamically balanced so that they are insensitive to natural vibrational frequencies in the range normally encountered in operation of counters of this type. In addition to this balance, there is a spacing provided between the actuating lever and cam detent which permits a small amount of play therebetween, which absorbs minor stray vibrations which may be transmitted through actuating lever. Also, cam actuating wheel assembly, shown in Figure 3, is also statically and dynamically balanced so that it is also insensitive to natural vibrations set up from outside the counter. By this unique combination of cascaded balancing from cam through arm and switch, it is possible to eliminate natural vibrations from affecting micro switch itself and the use of damping means in the counter have been completely eliminated.

It is to be understood that the variations in size and shape can be resorted to without departing from the spirit of my invention, as set forth in the appended claims.

I claim:

1. A switch actuator for a counter comprising a counter wheel having an outer cam surface, and an actuating lever pivotally mounted about a fulcrum at its center of gravity and adapted to be engaged by said cam surface at one end thereof, said lever being geometrically substantially symmetrical and having its weight substantially symmetrically distributed with respect to its center of gravity, whereby said lever is dynamically insensitive to resonant vibration.

2. A switch actuator for a counter as set forth in claim 1 wherein said cam counter wheel comprises a hub portion with a pair of diametrically opposed detents, an intermediate rim and gear portion with a plurality of internal grooves adapted to engage said detents, and an outer cam ring mounted on said rim and having a notch on the outer

periphery and a diametrically opposite notch on the inner periphery.

3. A switch actuator for a counter as set forth in claim 1 wherein at least one relieved portion is provided on each side of said fulcrum and equidistant therefrom.

4. A switch actuator for a counter as set forth in claim 1 wherein a plurality of cam wheels and ganged actuating levers are provided, and each of said levers is provided with a pair of relieved portions on opposite sides and equidistant from said fulcrum, alternate levers being interconnected by means extending through the relief of adjacent levers.

5. A switch actuator for a counter comprising a counter wheel having an outer cam ring with a notch on the outer periphery thereof and another counterbalancing notch at a diagonally opposite position on the inner periphery thereof, and a switch actuating lever pivotally mounted about a fulcrum at its center of gravity and positioned to be engaged by the outer periphery of said cam ring at one end thereof, said lever being geometrically substantially symmetrical about its center of gravity and having its weight substantially symmetrically distributed about its center of gravity whereby said lever is dynamically insensitive to resonant vibration.

6. A switch actuator for a counter comprising a counter wheel having an outer cam ring and a switch actuating lever pivotally mounted about a fulcrum at its center of gravity and positioned to be engaged by said cam ring at one end thereof, a spring pressed plunger mounted in the other end of said lever and adapted to engage said switch, said lever being geometrically substantially symmetrical about its center of gravity and having its weight substantially symmetrically distributed about its center of gravity whereby said lever is dynamically insensitive to resonant vibration.

7. A switch actuator for a counter comprising a counter wheel having an outer cam ring with a notch on the outer periphery thereof and another counterbalancing notch at a diagonally opposite position on the inner periphery thereof, and a switch actuating lever pivotally mounted about a fulcrum at its center of gravity and positioned for engagement at one end with said cam ring and at the other end with a switch, said lever being geometrically substantially symmetrical about its center of gravity and having its weight substantially symmetrically distributed about its center of gravity whereby said lever is dynamically insensitive to resonant vibration.

8. A switch actuator for a counter comprising a counter wheel having an outer cam ring with a notch on the outer periphery thereof and another counterbalancing notch at a diagonally opposite position on the inner periphery thereof, and a switch actuating lever pivotally mounted about a fulcrum at the center of gravity, said lever having a slot adjacent one end thereof with a cam follower roller mounted therein to engage said cam ring and a hole adjacent the opposite end thereof with a spring pressed plunger mounted therein, said slot and said hole being substantially equidistant from said fulcrum, said lever being geometrically substantially symmetrical and having its weight substantially symmetrically distributed with respect to its center of gravity, whereby said lever is dynamically insensitive to resonant vibration.

9. A switch actuator for a counter comprising a counter wheel having an outer cam ring with a notch on the outer periphery thereof, a switch with an operating plunger, and a switch actuating lever pivotally mounted about a fulcrum at its center of gravity, said lever having a slot adjacent one end thereof with a cam follower roller mounted therein to engage said cam ring and a hole adjacent the opposite end thereof with a spring pressed plunger mounted therein to engage and actuate said plunger, said lever being positioned with respect to said cam ring and said plunger when said roller is in said notch so that a slight space is provided therebetween, said slot and said hole being substantially equidistant from said fulcrum, said lever being geometrically substantially symmetrical and having its weight substantially symmetrically distributed with respect to its center of gravity, whereby said lever is dynamically insensitive to resonant vibration.

10. In a counter having a counter wheel with a cam surface on the outer periphery and a switch with an operating plunger, the improvement comprising a switch actuating lever pivotally mounted about a fulcrum at its center of gravity and adapted to be engaged by said cam surface at one end thereof and engage and actuate said switch at the opposite end thereof, said lever being geometrically substantially symmetrical and having its weight substantially symmetrically distributed with respect to its center of gravity, whereby said lever is dynamically insensitive to resonant vibration.

11. In a counter having a counter wheel with a cam surface on the outer periphery and a switch with an operating plunger, the improvement comprising a switch actuating lever pivotally mounted about a fulcrum at its center of gravity, said lever having a slot adjacent one end thereof with a cam follower roller mounted therein and a hole adjacent the opposite end thereof with a spring pressed plunger mounted therein, said slot and said hole being substantially equidistant from said fulcrum, said lever being positioned for said roller to engage said cam surface and said plunger to engage and actuate said switch, said lever being geometrically substantially symmetrical and having its weight substantially symmetrically distributed with respect to its center of gravity, whereby said lever is dynamically insensitive to resonant vibration.

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