March 3, 1942. W. J. ERICH 2,275,011

INERTIA SWITCH

Filed July 24, 1940

Fig. 1

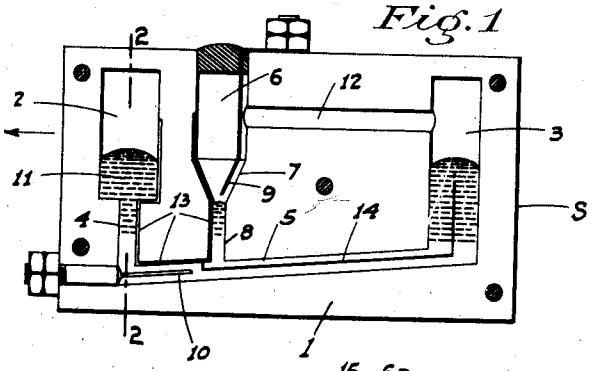


Fig. 2

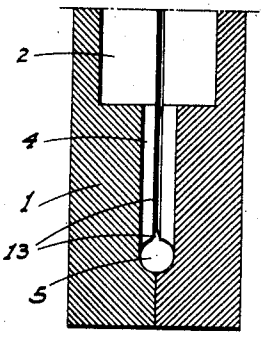


Fig. 3

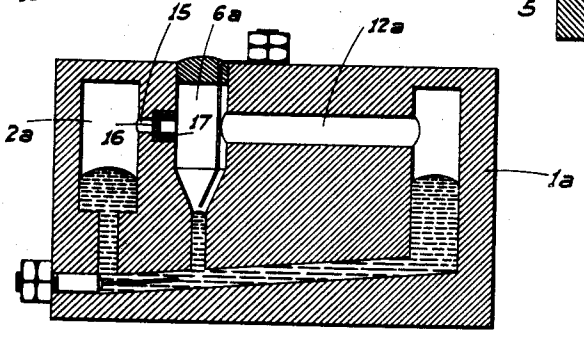
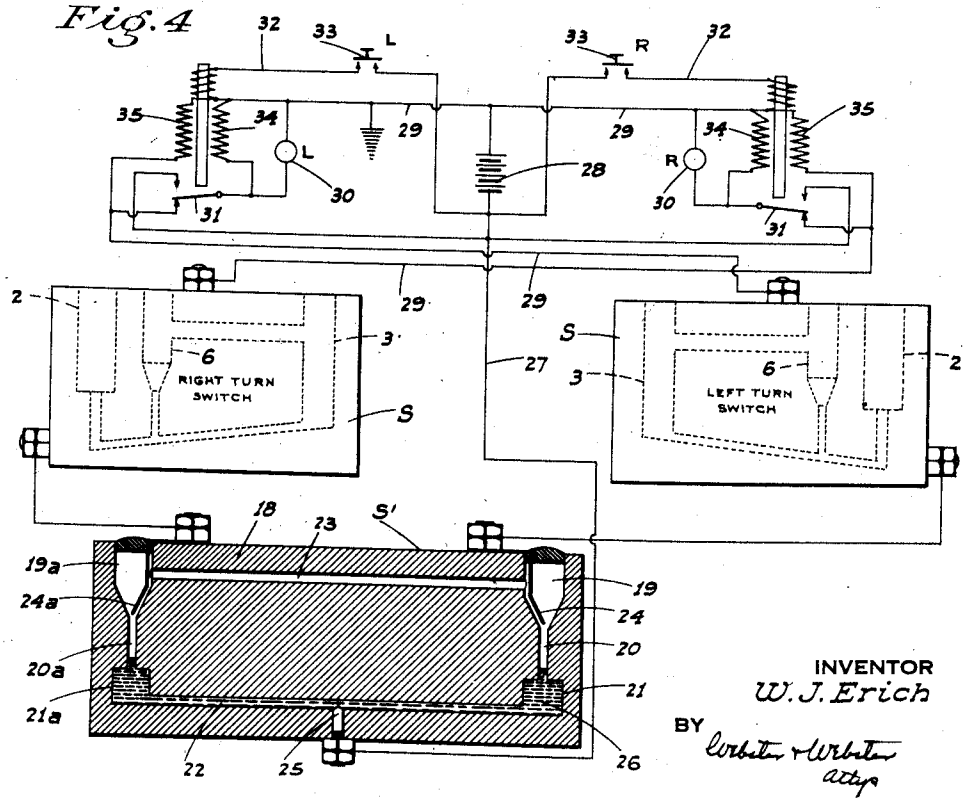


Fig. 4



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INERTIA SWITCH

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Application July 24, 1940, Serial No. 347,193

14 Claims. (Cl. 200—52)

This invention relates to an inertia switch particularly designed for motor vehicle use, and represents improvements over the switch shown in the copending application of Reuben Erich, Ser. No. 342,011, filed June 24, 1940.

One of the objects of the present invention is to provide a switch of this type having an improved form of mercury-flow restricting means which does not come in the same direct contact with the mercury as in said application, and hence is not subject to the uncertain operation obtained with the previous device.

Another object is to provide an improved switch unit especially designed for right or left hand signal giving, which is not affected or actuated by the straightening out movement of the vehicle after making a turn, nor by any sudden lateral tilt of the vehicle such as is caused by the wheels dropping into a chuck hole or the like.

A further object is to provide a switch which will be very insensitive to road shocks, etc.

A further object of the invention is to produce a simple and inexpensive device and yet one which will be exceedingly effective for the purpose for which it is designed.

These objects I accomplish by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawing similar characters of reference indicate corresponding parts in the several views:

Figure 1 is a sectional elevation of my improved switch in one form and as used for slow-down and stop signaling purposes.

Figure 2 is a fragmentary enlarged transverse section on line 2—2 of Fig. 1.

Figure 3 is a sectional elevation of a modified form of the switch.

Figure 4 is an assembly showing the multiple switch arrangement as used for right and left turn signals and including special circuits for the same.

Referring now more particularly to the characters of reference on the drawing, and particularly at present to Figs. 1 and 2, the switch S comprises a block-like body 1 of a material inert to mercury and adapted, when used for slow-down and stop signals, to be disposed in a vehicle lengthwise thereof.

Formed in the body adjacent its ends are enclosed vertical chambers 2 and 3, these chambers being preferably cylindrical and chamber 2 being of greater diameter than chamber 3. The chambers are connected by a passage which comprises a portion 4 depending from chamber 2 and a portion 5 sloping upwardly from the lower end of portion 4 to the bottom of chamber 3; said bottom being considerably lower than the bottom of chamber 2.

Another vertical chamber 6 is formed in the body between chambers 2 and 3 and relatively close to the former; the chamber 6 at its lower end sloping down at a relatively steep angle as at 7 to a junction with a depending passage 8 which taps and is of smaller diameter than passage 5. The upper end of passage 8 is about on a level with the bottom of chamber 2.

A suitable electrical contact 9 is brought into the chamber 6 in any convenient manner so as to terminate in the lower sloping portion 7 thereof. Another contact 10 is disposed in the passage 5 where it is always in direct contact with mercury, as for example as shown in Fig. 1. Mercury 11, in quantity sufficient to partially fill chambers 2 and 3 and to cause the mercury to normally rise in passage 8 to adjacent the top thereof, is initially poured into any chamber, and is then sealed against escape.

Owing to the small size of the passage 8, and the consequent capillary depression of the mercury, the latter will normally be higher in the end chambers than in said passage. For ease of manufacture, the switch is of the non-vacuum type. However, if found desirable, a suitable inert gas having approximately the same operating effect as air may be introduced into the switch to replace the air in the switch chambers.

In Figure 1 the switch is shown as being made in two identical matching halves, suitably connected together and arranged so as to have air-tight face to face engagement throughout their entire contacting areas.

In order to allow for a compensating flow of the confined air between the chambers as the mercury rises and falls therein, an air passage 12 connects the chambers 3 and 6 well above the mercury level, while another air flow restricting passage 13 connects the chambers 6 and 2. This latter passage is in the form of a narrow and small V-shaped groove, as shown in Fig. 2, which extends continuously along the matching edges of the two halves of the body in the walls of chambers 2 and 6 from above the mercury level, down the passages 4 and 8 and along the connecting portion of the passage 5 as clearly shown in Fig. 1. The width of the groove is sufficiently narrow so that no mercury will enter the same. In order to prevent possible separa-

tion of the mercury column by air action in the small passages, a very small relief or by-pass groove 14 is formed along the passage 5 in addition to and separate from the passage 13.

The passage 5 is sufficiently small to provide the required restriction of flow of the mercury, and acts to stabilize it. If this passage is unduly large, road shocks will disturb the mercury sufficiently to actuate the switch and cause a signal to be wrongly given.

The taper or funnel shape of the lower portion of chamber 6 induces a definite downward movement of the mercury after it has risen to engage contact 9. The incline of this taper must be sufficiently gradual to prevent a capillary hold-back action on the mercury, and yet sufficiently vertical to keep the mercury in a stabilized condition for satisfactory electrical contact under all conditions. Placing of the contact 9 close to the wall of the taper portion will decidedly facilitate the mercury entering the contact chamber.

In the type of switch shown in Fig. 3, the construction and arrangement generally is the same as above described. The body 1*a*, however, is here shown as being molded or cast in one piece and the passage 13 is omitted, its place being taken by another passage 15 between chambers 2*a* and 6*a* above the mercury level and alined with the air passage 12*a*. The passage 15 is initially relatively large, but is made to restrict an air flow therethrough by means of a disc 16, preferably of chamois skin, which is disposed in the passage 15 against a shoulder formed therein and held in place by an orificed plug 17 fitted in said passage ahead of the disc. Since the chamois skin or other similar material acts as a filter, it will pass the air therethrough, but will never become clogged with mercury regardless of the position of the switch and the mercury therein.

The desired action of the switch on a vehicle is made possible by the fact that an inertia impulse is practically instantaneous, whereas gravity action on a grade is not instantaneous, but takes place over a period of time. In the actual operation of the switch on a vehicle, any appreciable slow-down or decelleration of speed will cause the mercury to transfer from chamber 3 to chamber 6 and close the electrical circuit. Gravity is overcome by the slower leveling-off action of the mercury in the chambers 3 and 2. The speed of the leveling-off action can be controlled, in several ways, as by the use of the special air passage 13, the restricting disc 16, by a combination of both, or by any other suitably controlled air passageway between chambers 2 and 6. It is very important that the gravity leveling-off between the chambers 3 and 2 shall not be too fast, as otherwise too much mercury will transfer from chamber 3 into chamber 2 instead of to chamber 6, which would result in an insufficient signal being given. If, however, the leveling-off is made too slow, it will incorrectly take care of the gravity.

The sensitivity of action and the power of mercury movement may be increased by increasing the distance between chambers 6 and 3. In practice, the switch is designed to actually be more sensitive than necessary. In order to reduce road shock, this extra power is sacrificed to make possible the use of small diameter mercury restricting or stabilizing passages 5 and 8. The effect of these small diameters is that it introduces a stabilizing restriction to the flow of mercury which results in overcoming any objectionable action due to road shock. The small diameter of passage 8 also has the effect of providing sufficient capillary depression to maintain a lower mercury head in passage 8 than in passage 3. The advantage of this is that it makes the switch very much more sensitive than would otherwise be possible if the mercury levels in chamber 3 and passage 8 were equal. This also allows the desirable greater spacing between mercury 11 and contact point 9 in chamber 6, when the switch should be off.

Since the over-all restriction in passage 8 is a definite amount, the diameter, length and roughness or smoothness of bore are very important factors. For instance, a rough bore surface will have considerably less resistance to mercury flow than a smooth one.

The diameter of chamber 3 is also important, inasmuch as a large diameter will supply more mercury to the chamber 6 without losing an appreciable height of the mercury head when an inertia impulse takes place. This is true because the mercury in the passage 8, due to the small diameter of the latter, will rise very rapidly in relation to the drop in the chamber 3. The length of the chambers 3 and 2 are determined by the maximum road grade on which operation is desired. The diameter of chamber 2 is adjusted relative to that of chamber 3 so that the mercury will maintain a constant level in chamber 8 under static conditions regardless of the tilt of the switch.

For giving a right or left hand turn signal, I use a double-acting instantaneous limited gravity correction inertia switch as shown in Fig. 4. This switch S' comprises a body 18 adapted to be mounted transversely of the vehicle and having a pair of identical vertical chambers 19 and 19*a* adjacent its ends. Relatively small passages 20 and 20*a* depend from chambers 19 and 19*a* respectively. These passages connect with enlarged mercury reservoirs 21 and 21*a* respectively disposed directly below the corresponding chambers 19 and 19*a*. The reservoirs are connected by a relatively small diameter mercury passage 22. The chambers 19 and 19*a* are connected by an air passage 23 which is at all times above the mercury level. A contact 24 for a left hand turn is disposed in the chamber 19, while a contact 24*a* for a right hand turn is disposed in the chamber 19*a*. A common electrical contact 25 enters the passage 22 where it will be in constant contact with the mercury 26.

This mercury is placed in the switch in sufficient quantity to cause the mercury to fill the reservoirs 21 and 21*a* and extend very slightly up into passages 20 and 20*a* when the switch is in a level and static position.

The maximum gravity angle that the switch can take care of instantaneously is limited to the angle or point at which the mercury will rise in either passage 20 or 20*a* and make contact with the corresponding contact point 24 or 24*a* when the switch is tilted. This maximum gravity angle can be increased by lengthening the passages 20 and 20*a*. The connecting passage 22 between the reservoirs must also then be lengthened to provide the required additional power to maintain the needed sensitivity.

The purpose of the enlarged mercury supply reservoirs is to assure a sufficient quantity of mercury to supply the amount required to rise in the passages 20 and 20*a* and make and main-

tain the desired contact either with contact point **24** or **24***a*. The action of this switch in many respects is obviously similar to that of the switch described in Fig. 1.

If additional belated gravity compensation is desired, it may be obtained by correctly connecting in series with each circuit, leading to the contact points **24** and **24***a*, an inertia switch of the type shown in Fig. 1 and as illustrated in Fig. 4. In this case, the body of the switch S for the left turn signal is disposed transversely of the vehicle with the chamber **2** facing to the right, while the switch for a right turn signal is disposed with its chamber **2** facing to the left. The contact **10** of the two switches S as above disposed are connected to the contacts **24** and **24***a* respectively of the switch S'.

In case it is desired to give a left hand signal, for instance, the mercury in switch S' will transfer from reservoir **21***a* to contact chamber **19**, thus closing the electrical circuit between contacts **24** and **25** (and also between the contacts **9** and **10** of the corresponding switch S as the latter is used), thus causing the left hand signal light to function. The reverse action is of course true when obtaining a right hand turn signal.

A specially designed relay circuit with manually operated push-button control may be used to give a signal ahead of time to indicate an intention to make a turn of any desired distance before such turn is made.

This special circuit for the switch S' and for switch S if such is used, comprises a wire **27** leading from the contact **25** to the battery **28**, from which another wire **29** leads to the contact **9** of the switch S, with a signal light **30** interposed in said wire and also a normally closed relay switch **31** positioned between the light and said contact **9**. Therefore, when the contacts **9** and **10**, as well as contacts **24** and **25** are closed, the light will function.

An auxiliary relay energizing circuit **32** has a normally open push-button switch **33** therein, which when closed energizes the relay. This causes the switch **31** to open with respect to wire **29**, but to close with respect to a relay holding circuit **34**. This circuit **34** is connected in parallel with the signal light circuit so that the relay will remain energized after the push-button switch is opened, and the light will still continue to function. A relay breaking winding **35** is connected in parallel with the signal light circuit in by-passing relation to the switch **31**, so that when the contacts of the inertia switches are subsequently closed, as when a turn is being actually made, the relay will be deenergized, which restores the switch **31** to its original closed position in the signal circuit wire **29**, and the light will continue to function until the circuit is broken at the contacts of the inertia switches.

When the vehicle straightens out at the end of the turn, the mercury **26** will disengage itself from the contact point **24** (or from contact point **9** of switch S), and the signal light circuit will be automatically opened and the signal light will of course be extinguished. It is thus obvious that the only manual requirement is the operation of the push-button switch to turn on the wanted signal light to indicate an intent to turn in the corresponding direction, ahead of the actual turn being made. If, however, the driver fails to thus indicate his intention, the signal light will automatically function with the start of the actual turn, and in any case will always be automatically discontinued when the vehicle is straightened out.

From the foregoing description it will be readily seen that I have produced such a device as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of the device, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

Having thus described my invention, what I claim as new and useful and desire to secure by Letters Patent is:

1. A gravity correction inertia switch comprising a body, a pair of vertical spaced chambers therein, a contact in one chamber, a relatively small mercury filled passage connecting the chambers at the bottom, a contact in said passage, an air passage connecting the chambers above the mercury level, and air flow restricting means in said air passage.

2. A switch as in claim 1, in which said restricting means comprises a porous disc extending across the passage.

3. A gravity correction inertia switch comprising a body, a pair of vertical spaced chambers therein, a contact in one chamber, a relatively small mercury filled passage connecting the chambers at the bottom, a contact in said passage, and means forming a restricted air flow passage connecting the chambers.

4. A gravity correction inertia switch comprising a body, a pair of vertical spaced chambers therein, a contact in one chamber, a relatively small mercury filled passage connecting the chambers at the bottom, a contact in said passage, and means forming a restricted air flow passage connecting the chambers; said means comprising a continuous narrow groove extending down the walls of the chambers and along the connecting passage.

5. An inertia switch comprising a body, a pair of vertical spaced chambers therein, a contact in one chamber, a relatively small mercury filled passage connecting the chambers at the bottom, a contact in said passage adjacent the other chamber, the wall of said one chamber near the bottom sloping sharply down to a junction with the passage and the contact depending in the chamber to a termination adjacent but above said passage.

6. An inertia switch comprising a body, a pair of vertical spaced chambers therein, one chamber terminating at a lower level than the other chamber, a passage between the chambers including a portion depending from the bottom of said other chamber to a level below the bottom of the one chamber and a portion sloping thence upwardly to the bottom of the one chamber, mercury partially filling the chambers and filling the passage, a third vertical chamber in the body between the pair of chambers, the bottom of said third chamber being substantially on a level with the bottom of said other chamber, a relatively small mercury filled passage depending from the third chamber and connected to the sloping portion of the first passage, contacts in the third chamber near the bottom and in the first passage near said one chamber, and an air passage between said one chamber and the third chamber.

7. A switch as in claim 6, in which the third

chamber is closer to said other chamber than to said one chamber.

8. A switch as in claim 6, in which said other chamber is of greater cross-sectional area than said one chamber.

9. An inertia switch comprising a body, a pair of vertical spaced chambers therein, a contact in one chamber, a relatively small mercury filled passage connecting the chambers at the bottom, a contact in said passage adjacent the other chamber, an air passage connecting the chambers above the mercury level, the mercury passage throughout its extent being formed with a small air-relief groove in the wall thereof.

10. A switch as in claim 3, in which said mercury passage is of a size sufficiently small to effect a dampening out of mercury movement due to road shock.

11. A switch as in claim 3, in which the bottom of the chamber in which the contact is disposed is tapered to an extent such as to stabilize the electrical contact and facilitate the downward movement of the mercury after an inertia impulse.

12. A double-acting instantaneous gravity correction inertia switch for right and left turn signaling comprising a body, a pair of vertical horizontally spaced chambers therein, a contact point in each chamber, means including a relatively small horizontal mercury filled passage connecting the chambers, a contact permanently engaging the mercury, and an air passage connecting the chambers above maximum mercury level.

13. A double-acting instantaneous gravity correction inertia switch for right and left turn signaling comprising a body, a pair of vertical horizontally spaced chambers therein, a contact point in each chamber, relatively small passages depending from the chambers, enlarged mercury reservoirs with which said passages connect at their lower end, a relatively small passage connecting the reservoirs at the bottom, mercury normally filling the reservoirs and said last named passage, a contact permanently engaging the mercury and an air passage connecting the chambers above the maximum mercury level.

14. An inertia switch comprising a body, a pair of vertical spaced chambers therein, a passage below and connecting the chambers and including portions of relatively small size at their junction with the chambers, mercury filling the passage and partially filling the chambers, a contact projecting into the passage and a contact in one chamber normally clear of the mercury.

WILLIAM J. ERICH.