Aug. 16, 1966 W. C. SHAW ET AL 3,267,226

DETENT MECHANISM FOR CONTROL APPARATUS

Filed Oct. 3, 1963 2 Sheets-Sheet 1

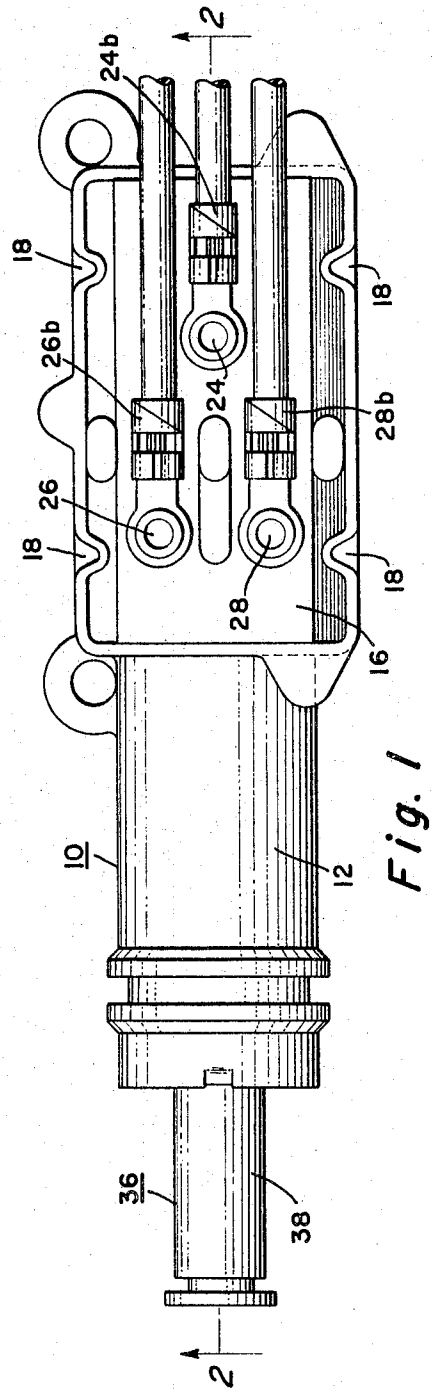


Fig. 1

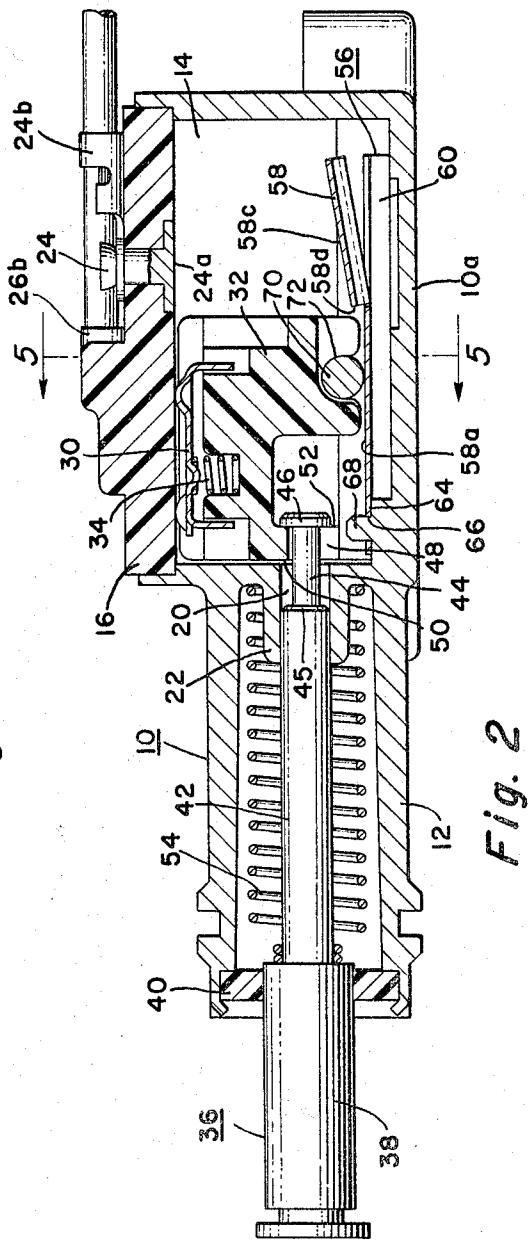


Fig. 2

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DETENT MECHANISM FOR CONTROL APPARATUS

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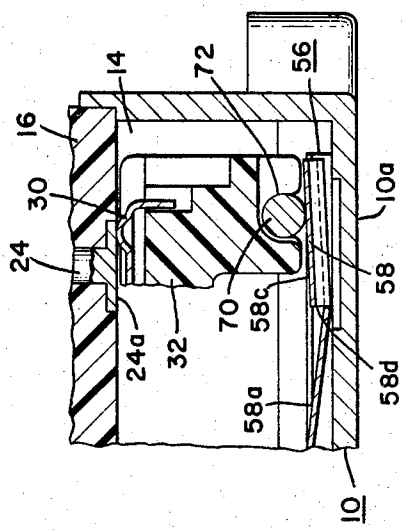


Fig. 4

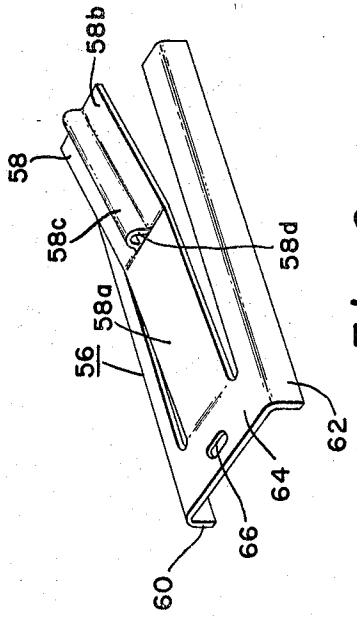


Fig. 6

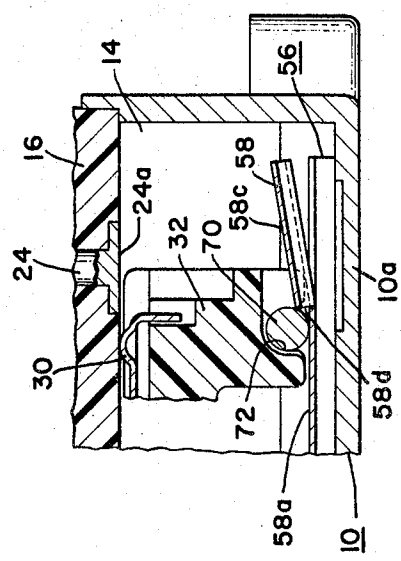


Fig. 3

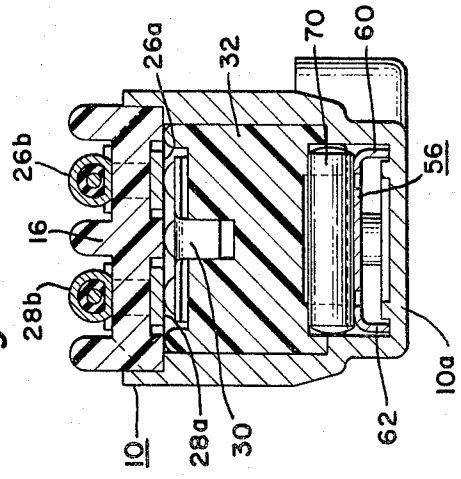


Fig. 5

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3,267,226 DETENT MECHANISM FOR CONTROL APPARATUS

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This invention relates to detent mechanism for control apparatus such as an electric switch that is capable of indicating to the operator of the apparatus that he has actuated the apparatus to a predetermined position.

It is common practice in the control apparatus art, such as in electric switches, to provide a detent mechanism for detenting a contact carrier in various positions. This type of detent mechanism has taken various forms and in certain instances an axially spring biased ball has been used which cooperates with one or more recesses formed in a fixed support. In other arrangements that have been used in turn signal apparatus a roller is rotatably mounted on a shaft and cooperates with a spring which has a waved shape.

The present invention in contrast to the above mentioned detents for electric switches is concerned with providing a reactive force to the movement of a plunger when the plunger and the device it is operating have been moved to a predetermined point. This reactive force provides what may be termed "detent feel" since no reactive force is encountered until this point is reached and after this point is past the reactive force is no longer present.

It is accordingly one of the objects of this invention to provide a device which is capable of exhibiting a force that can be felt by the operator of the control apparatus when the control apparatus is moved to a certain point and wherein this force no longer exists when this point is past.

Another object of this invention is to provide a feel mechanism for a control apparatus that includes a spring finger that is engaged by a shiftable element. The spring finger is supported in cantilever fashion such that when the shiftable element engages an abutment means on the spring finger, reactive force is felt by the operator, and when the shiftable element is moved further the spring finger is bent and the reactive force is greatly reduced.

Another object of this invention is to provide a detent feel mechanism for control apparatus such as an electric switch wherein a cylindrical element is interposed between a shiftable element and a spring finger, the spring finger having an abutment means which provides the reactive force when the cylindrical element is moved to engage the abutment means. In carrying this object forward the cylindrical element engages the spring finger and a pair of side rails disposed on opposite sides of the spring finger and forming with the spring finger an integral part that can be attached to a fixed support.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a top plan view of a control apparatus that uses the detent feel mechanism of this invention.

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1.

FIGURE 3 is a sectional view of a portion of FIGURE 2 and showing the position where a reactive force is first felt by an operator of the control apparatus.

FIGURE 4 is a view similar to FIGURE 3 but illustrating the control apparatus in a position where the reactive force has been overcome.

FIGURE 5 is a sectional view taken along line 5—5 of FIGURE 2.

FIGURE 6 is a perspective view of a spring detent used in FIGURE 2.

The detent feel mechanism of this invention is to be described in connection with an electric switch, but it is to be understood that this mechanism could be used in other manually operable devices where it is desired to indicate to the operator that the device has been moved to a predetermined position by causing a force to be felt by the operator when this position is reached.

Referring now to the drawings and more particularly to FIGURES 1 and 2, the reference numeral **10** generally designates a metal housing having a tubular section **12** and a rectangular section defining a switching compartment **14**, an insulator plate **16** that closes the open end of the compartment **14**. The insulator plate **16** is secured to the housing **10** by staking portions of the housing over the insulator as indicated by reference numeral **18**. The interior of the tubular section **12** communicates with the compartment **14** through an opening **20** which is surrounded by a boss **22** formed as an integral part of the housing **10**.

The insulator plate **16** carries rivets **24**, **26** and **28** which pass through openings in the insulator plate. The rivets **24**, **26** and **28** each have a contact surface which form the fixed contacts for the switch. These contact surfaces are designated by reference numerals **24***a*, **26***a* and **28***a*.

The rivets **24**, **26** and **28** hold terminals **24***b*, **26***b* and **28***b* fixed with respect to the insulator plate **16** and these terminals are connected with conductors as shown.

The contact surfaces of the rivets **24**, **26** and **28** are connected in a predetermined sequence by a metal contactor **30** which is carried by a contact carrier **32** that is formed of insulating material. The contactor **30** has a triangular shape and has sections extending downwardly into slots formed in the contact carrier **32**. A spring **34** urges the contactor **30** toward the contact faces of the rivets **24**, **26** and **28**. The triangular shape of the contact **30** makes it possible for this contact to electrically disconnect the rivets **24**, **26** and **28** when the contact carrier is in its FIGURE 2 position. When the contact carrier is shifted rightwardly a predetermined distance, the contact **30** will electrically connect the rivets **26** and **28** to provide the first switching position of the switch. When the contact carrier is shifted rightwardly in FIGURE 2 to its FIGURE 4 position contact **30** will electrically connect the rivets **24**, **26** and **28** to provide another switching position for the switch.

The contact carrier **32** is shifted by a plunger generally designated by reference numeral **36**. The plunger **36** has a cylindrical section **38** which slides in a bushing **40** secured to the housing **10**. The cylindrical section **42** of the plunger **36** slides in the boss **22**. The plunger **36** has a reduced section **44** and an annular section **46**. The reduced section **44** fits within a slot **48** formed in the contact carrier **32** and the wall section **45** of the plunger **36** can engage a wall **50** of the contact carrier that surrounds slot **48** when the plunger is depressed. When the plunger moves back, the section **46** engages wall **52** of the contact carrier. A spring **54** is interposed between the end of plunger section **38** and the housing **10** and constantly urges the plunger and contact carrier **32** to the position shown in FIGURE 2.

The electric switch of this invention is adapted to control the downshifting of an automatic transmission on a motor vehicle. Thus, the plunger **36** can be suitably connected with the accelerator pedal on a motor vehicle such that when the accelerator pedal is depressed by the operator the plunger **36** is moved rightwardly in FIGURE 2.

With this type of apparatus it is necessary that the operator feel some reactive force just prior to the time that

the automatic transmission is to be downshifted. This reactive force is provided by a spring detent which is generally designated by reference numeral **56** and is shown in the perspective view of FIGURE 6. It is seen that the spring detent **56** has a spring finger **58** which is laterally spaced from a pair of L-shaped side rail sections **60** and **62**. This spring detent **56** is formed of spring steel material. The spring finger section **58** has offset sections **58***a* and **58***b*. The section **58***b* has a raised section **58***c* forming an abutment **58***d*. In the normal unstressed position of the spring finger it takes a position slightly above its position shown in FIGURE 2. It is seen that this spring finger **58** is supported in cantilever fashion by the section **64** of the detent spring which joins one end of the side rail sections **60** and **62**. The section **64** has an opening **66** which receives a projection **68** formed integral with the housing **10**. It thus is seen that the spring detent **56** is supported by the lower wall **10***a* of the housing **10** since the side rail sections **60** and **62** engage this wall. The spring detent **56** is prevented from axial movement since the opening **66** receives the projection **68**.

The spring finger **58** cooperates with an elongated cylindrical element **70** which fits within a slot **72** formed in the contact carrier **32**. The cylindrical element **70** is formed of steel material and its ends engage surfaces on the contact carrier **32** as depicted in FIGURE 5 to prevent axial movement of the cylindrical element **70**. It will be appreciated that as the contact carrier **32** is shifted, the cylindrical element **70** slides on the top surface of the spring finger **58** and also slides on the top surface of the side rail sections **60** and **62**.

The operation of the reactive force mechanism of this invention in connection with the electric switch will now be described. When the plunger **36** is moved rightwardly in FIGURE 2, as by the depressing of an accelerator pedal in a motor vehicle which is connected by suitable linkage with the plunger **36**, the plunger will move to a position where the plunger wall **45** engages the wall **50** of the contact carrier **32**. It can be seen that there is some overtravel of the plunger **38** before it actually will move the contact carrier **32**.

During continued movement of the plunger **36** to the right in FIGURE 2 the contact carrier **32** is moved rightwardly and the cylindrical element **70** is moved rightwardly and slides along the top surface of section **58***a* of the spring finger **58**. The only forces now impeding the movement of the contact carrier are the force of the spring **54**, the frictional force between cylindrical element **70** and section **58***a* and the minor frictional force of the contactor **30** sliding along the inner surface of the insulator plate **16**.

When the cylindrical element **70** engages the abutment **58***d* as shown in FIGURE 3 the operator will now feel a positive reactive force to further movement of the plunger **36**. This will indicate to the operator that the contact carrier **32** has been shifted to a predetermined position and that further movement of the contact carrier will now cause certain switching to take place. Thus, where the control apparatus is used to control the downshifting of an automatic transmission the force provided when the cylindrical element **70** engages abutment **58***d* will indicate to the operator that further movement of the accelerator pedal will now cause the transmission to be downshifted.

If the operator now continues movement of the plunger **36** rightwardly, the spring finger **58** will be bent downwardly between the side rail sections **60** and **62** as depicted in FIGURE 4 and the cylindrical element **70** will then slide on the section **58***c* and side rail sections **60** and **62** of the spring finger **58**. The reactive force that was present when the cylindrical element **70** engaged the abutment **58***d* will now no longer exist and the contact carrier **32** can be moved relative to section **58***c*. The arrangement of parts is such that when the cylindrical element **70** is on surface **58***c* the contactor **30** connects the rivets **24**, **26** and **28**.

When the operator releases the plunger **36**, as when the accelerator pedal is released, the spring **54** will return the plunger **36** and the contact carrier **32** to the FIGURE 2 position. When the plunger **36** moves leftwardly it does not move the contact carrier **32** until the section **46** of the plunger engages the wall **52** of the contact carrier **32**. The plunger thus overtravels both during initial rightward movement and when it is being returned leftwardly by the spring **54**. In the FIGURE 2 position of the contact carrier, one end **50** of the contact carrier engages a wall of the housing **10** as is apparent from FIGURE 2.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A control apparatus comprising, a housing, a spring detent member having a pair of side rail sections and a spring finger located therebetween, the lower edges of said side rail sections engaging said housing, a shiftable control member shiftable relative to said spring detent and relative to said support member, and means shiftable with said shiftable member and engageable with said spring finger, said means being engageable with the top edges of said side rail sections, said spring finger having an abutment means which engages said means when said control member is moved to a predetermined position to provide a reactive force to further movement of said control member.

2. The control device according to claim **1** wherein the control member is the contact carrier of an electric switch that carries a contact that is engageable with a fixed contact supported by said housing.

3. The control device according to claim **1** wherein the means that is driven by the control member is cylindrical in shape and fits within a slot formed in the control member.

4. The control device according to claim **1** wherein the spring detent has an opening which receives a projecting portion of the support means for preventing axial movement of said spring detent.

5. In combination, a manually operable member, a housing, a control member adapted to be moved by said manually operable member, said control member being slidably supported by said housing for movement along a predetermined path, an elongated spring finger mounted in cantilever fashion on said housing, and an element engageable with and movable on one surface of said spring finger, said element being located between and in engagement with said control member and said one surface of said spring finger and being moved by said control member along a predetermined path, said spring finger in one position extending into said predetermined path of movement of said element and having an abutment means which is engaged by said element to provide a reactive force to further movement of said control member when said element is shifted into engagement with said abutment means, said reactive force being overcome when said spring finger is bent toward said housing by said element and to a position substantially parallel to said predetermined path of movement of said element when said shiftable member is shifted past a point where said element engages said abutment means.

6. In combination, a housing, a manually operable control member slidably supported by said housing for movement along a predetermined path relative to said housing, a spring finger mounted in cantilever fashion at one end on said housing, said spring finger extending into said predetermined path when it is in one position, said spring finger having an abutment means located in said predetermined path of movement of said control member, and an element disposed between said control member and said spring finger and riding on one face of said spring finger when said control member and element are moved, said element being shifted by said control member and engaging said abutment means of said spring

finger in one position of said element and spring finger to apply a reactive force to further movement of said control member, said spring finger being bent toward said housing by said element when said control member and element are moved to a position where said element overrides said abutment means to thereby reduce the reactive force force applied to said control member.

7. In combination, a housing, a manually operable control member slidably supported by said housing for movement along a predetermined path, a spring finger supported at one end on said housing having an abutment means, and an element located between said control member and said spring finger which rides on one surface of said spring finger as said control member is shifted, said control member including means for driving said element along a predetermined path, said spring finger having an abutment means and being capable of being bent with respect to said housing and having a position where it extends into said predetermined path of movement of said element, said element engaging said abutment means to provide a reactive force to further movement of said control member when said element is shifted into engagement with said abutment means, said spring finger bending towards a position where it is located substantially parallel to said predetermined path of movement of said element when said control member and element are shifted past a point where said element engages said abutment means whereby said reactive force is reduced.

8. The combination according to claim 7 where the control member is a contact carrier which carries an electrical contact that is engageable with a fixed contact supported by said housing.

9. A control device comprising, a housing, a plunger slidably supported on said housing for axial reciprocation relative to said housing, a spring interposed between said housing and said plunger for urging said plunger in one direction, a control member connected with said plunger to be axially reciprocated thereby, and a means for providing a reactive force to movement of said control member and said plunger when said plunger and control member are moved against the bias of said spring to a predetermined position, said means including an elongated spring finger which is supported at one end by said housing and which includes an abutment means that is engageable with an element that is driven by said control member in said predetermined position of said control member, said element being disposed between said control member and said elongated spring, said spring finger extending into the path of movement of said element in one position of said spring finger, said spring finger being bendable and being bent to a position where said element moves along a surface of said spring finger to reduce said reactive force when said control member and plunger are moved past said predetermined position.

10. A control apparatus comprising, a housing, a control member slidably supported by said housing for movement along a predetermined path relative to said housing, an elongated flat spring finger having an abutment means,

one end of said spring finger being supported on said housing, and an element driven by said control member located between said control member and a surface of said spring finger whereby said element rides on said surface of said spring finger when said control member is shifted, said spring finger having one position where it extends into the path of movement of said element that is driven by said control member, said element being operated by said control member to bend said spring finger downwardly towards a position substantially parallel to the path of movement of said element when said control member is moved past a predetermined point where it engages said abutment means, said spring finger providing a reactive force to movement of said control member when said control member has been moved to a point where said element engages said abutment means, said reactive force being reduced when said spring finger is bent downwardly when said element is moved past said abutment means.

11. A control apparatus comprising, a housing, a control member slidably supported on said housing for movement along a predetermined path, said control member being movable between first, second and third positions, an element connected with said control member and shifted thereby along a predetermined path of movement, an elongated flat spring finger having an abutment means supported at one end by said housing, said spring finger in one position thereof extending into said predetermined path of movement of said element, said element riding on one surface of said spring finger and being located between said control element and said spring finger, said element being spaced from said abutment means in said first position of said control member but engaging said abutment means when said control member is shifted from said first position to said second position, said element being operative to bend said spring finger downwardly towards a position substantially parallel to said predetermined path of movement of said element when said control member is shifted through its second position towards its third position, said spring finger providing a reactive force to the movement of said control member when said control member has been moved to its second position where said element engages said abutment means, said reactive force being reduced when said control member and element are shifted through said second position toward said third position.

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