Feb. 3, 1959 R. R. HAGER 2,872,540

GOVERNOR SWITCH

Filed Feb. 24, 1958 3 Sheets-Sheet 1

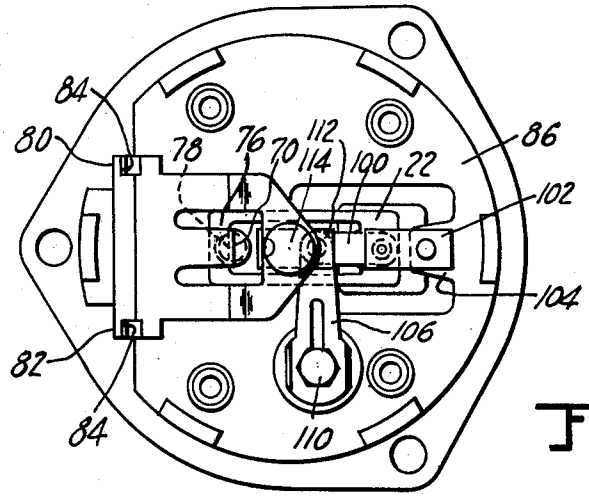


FIG. 2

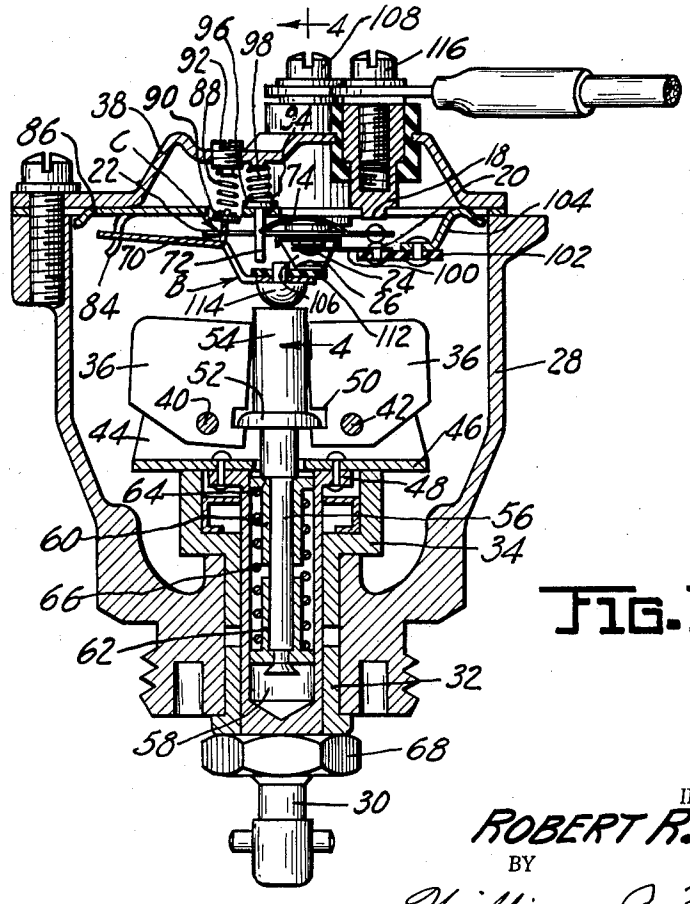


FIG. 1

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GOVERNOR SWITCH

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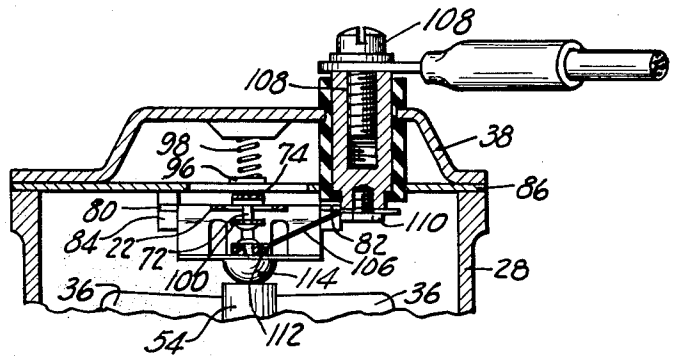


FIG. 4

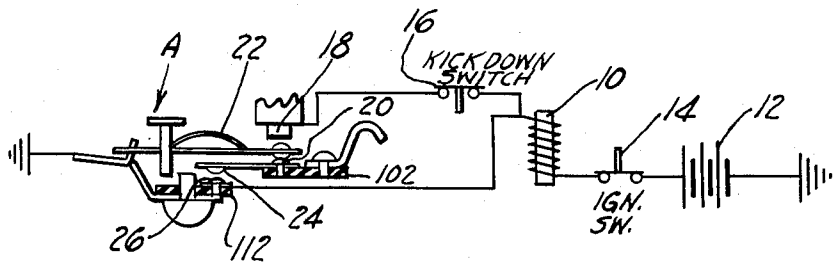


FIG. 3

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GOVERNOR SWITCH

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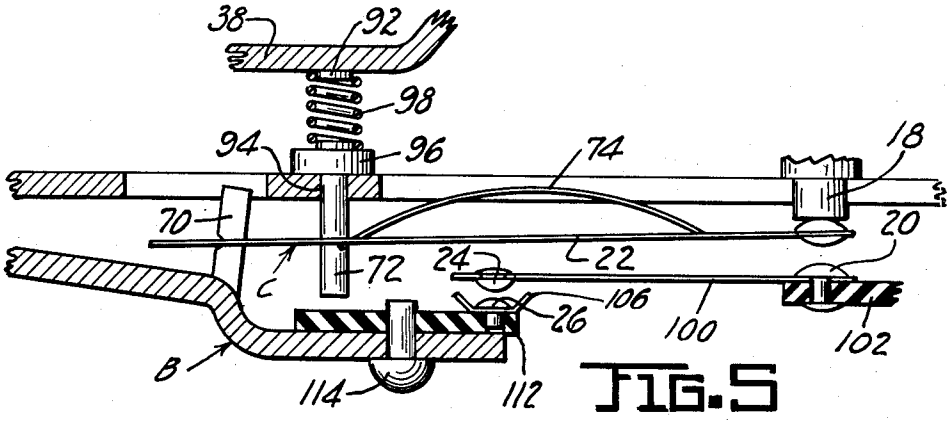


FIG. 5

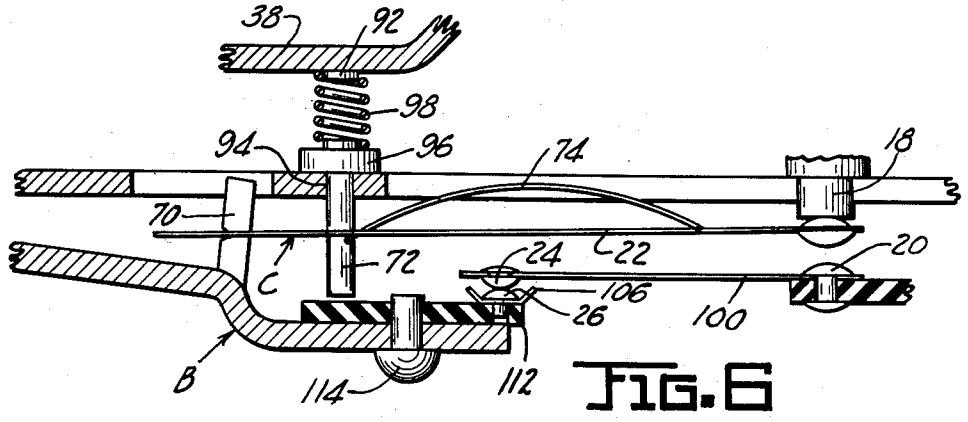


FIG. 6

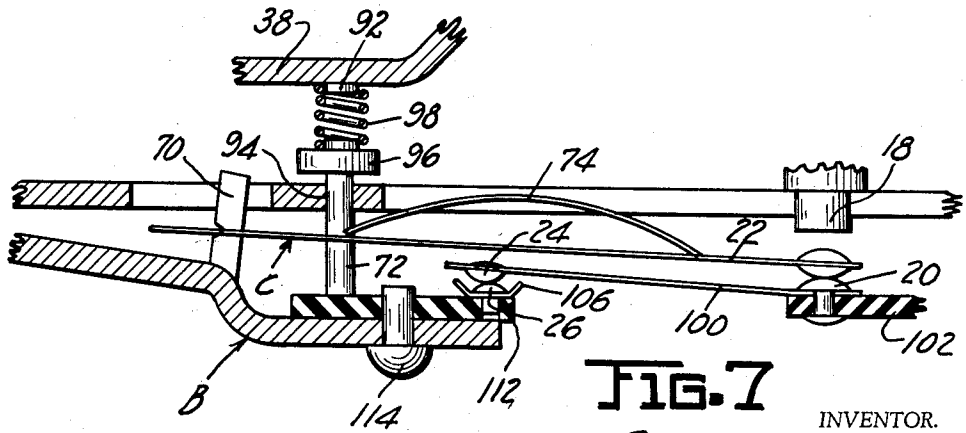


FIG. 7

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GOVERNOR SWITCH

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Application February 24, 1958, Serial No. 717,249

5 Claims. (Cl. 200—67)

The present invention relates to snap-acting switch means; and more particularly to switch means which will sequentially close a pair of electrical circuits upon movement of a control member in a given direction in a snap-acting manner while employing but a single snap-acting means.

An object of the present invention is the provision of a new and improved snap-acting switch having a single snap acting switch structure and electrical contacts in two separate electrical circuits that are sequentially operated upon movement of a control member in a given direction to snap closed one of the circuits while the other is open and thereafter snap open the first circuit and snap closed the second circuit.

A further object of the present invention is the provision of a new and improved snap-acting governor switch of the above described type which is simple and rugged in its design, efficient and reliable in its operation, and can be cheaply manufactured on a mass production basis.

The invention resides in certain constructions and combinations and arrangements of parts; and further objects and advantages of the invention will become apparent to those skilled in the art to which the invention relates from the following description of the preferred embodiment described with reference to the accompanying drawings forming a part of this specification, and in which:

Figure 1 is a cross-sectional view of a governor switch embodying principles of the present invention;

Figure 2 is a bottom view of the cover plate shown in Figure 1 showing its attached switch structure;

Figure 3 is a schematic wiring diagram of an overdrive control circuit for an automotive vehicle which schematically illustrates the control functions of the switch shown in Figure 1;

Figure 4 is a fragmentary cross-sectional view taken approximately on the lines 4—4 of Figure 1;

Figure 5 is a fragmentary cross-sectional view showing a first stage of the operation of the switch structure shown in Figure 1;

Figure 6 is a fragmentary cross-sectional view similar to that shown in Figure 5 in which the switch parts are positioned in a second stage of its operation;

Figure 7 is a fragmentary across-sectional view similar to that shown in Figures 5 and 6 but showing the switch structure in still another stage of its operation.

An understanding of the construction and operation of the switch structure shown in Figure 1 can most easily be obtained after knowledge is had of the functions which the switch performs in the overdrive control circuit shown in Figure 3 of the drawings.

A type of transmission used in the drive train of an automotive vehicle and which is commonly called an "overdrive" provides what in effect is a fourth gear arrangement of low numerical ratio which is usually brought into operation semi-automatically when the speed of vehicle exceeds a generally predetermined rate. Inasmuch as the overdrive arrangements currently being used decreases the number of engine revolutions per wheel revolution to approximately seven-tenths of its third gear arrangement, the torque delivered to the drive wheels is greatly reduced when the overdrive is in operation particularly at low vehicle speeds. It is a further characteristic of interinal combustion engines that they produce a maximum torque at an engine R. P. M. well below the R. P. M. at which it produces maximum power; and it usually happens that the torque which the engine is capable of producing decreases appreciably at speed below and above their maximum torque R. P. M. The vehicle speed at which maximum engine torque is produced varies with the different make automobiles; but it is a well known fact that most automobiles having overdrive transmissions can accelerate fastest in its third gear below speeds of approximately 60 M. P. H., and at speeds above approximately 60 M. P. H. can accelerate fastest in its fourth gear or overdrive arrangement. Conventional overdrive transmissions employ a controlled circuit which prevents its fourth gear arrangement from being placed in operation until the vehicle has achieved a speed of approximately 30 M. P. H. At speeds between 30 and 60 M. P. H., a retraction of the vehicle's accelerator pedal automatically causes the fourth gear arrangement of the overdrive transmission to be brought into operation. As previously indicated most automobiles will accelerate fastest in its third gear arrangement below speeds of approximately 60 M. P. H., and accordingly the conventional overdrive circuit includes a kickdown switch which is brought into operation when the accelerator pedal is pressed to the floor, and which automatically causes the fourth gear arrangement of the overdrive transmission to be taken out of operation and the third gear arrangement to be brought into operation. This automatically permits a speed up of the engine, which enables the vehicle to be accelerated faster below vehicle speeds of approximately 60 M. P. H. After vehicle speeds of approxiamtely 60 M. P. H. are exceeded, however, the engine torque falls off to such an extent that the vehicle will best accelerate in its fourth gear arrangement. It is a desired object of the present invention, therefore, to provide a simple switch means which will disable the kickdown circuit after speeds of approximately 60 M. P. H. are reached, and thereby prevent the operator from inadvertently taking the overdrive transmission out of its fourth gear arrangement at these higher vehicle speeds.

The third gear arrangement of an overdrive transmission is adapted to be disengaged and the fourth gear arrangement is adapted to be brought into operation upon the actuation of the armature of the solenoid **10** (schematically illustrated in Figure 3) when its field winding is energized. The control circuit for the solenoid **10** includes a battery **12**, one terminal of which is grounded, the vehicle's ignition switch **14**, a kickdown switch **16**, and a first terminal or contact **18** of a speed responsive governor switch A that is driven at speeds proportional to the driving wheels of the vehicle. The kickdown switch **16** is a normally closed switch that is adapted to be opened whenever the vehicle's accelerator pedal is pressed to the floor, and which when opened de-energizes the solenoid **10** to cause the overdrive transmission to revert from its fourth gear arrangement back into its third gear arrangement. The governor switch A also includes a second contact **20** which is spaced apart from the first contact **18** and which is normally engaged by a switch blade **22** that is snapped into engagement with the first contact **18** after a vehicle speed of approximately 30 M. P. H. is exceeded. The blade **22** is grounded to complete an electrical circuit through the solenoid **10** and thereby cause the fourth gear arrangement of the overdrive transmission to be brought into operation.

According to principles of the present invention, the switch A also includes third and fourth normally open contacts 24 and 26 respectively which are connected in a by-pass circuit for the kickdown switch 16. The by-pass circuit when completed will hold the solenoid 10 energized such that opening of the kickdown switch 16 thereafter will no longer cause the transmission to be taken out of its fourth gear arrangement. As previously indicated this will preferably take place at a vehicle speed of approximately 60 M. P. H. In the embodiment shown in the drawings, the third contact surface 24 is in series electrical circuit with the second contact 20. The switch structure A is so constructed and arranged that the third and fourth contacts 24 and 26 will slowly be brought together after the blade 22 has been snapped into engagement with the first contact 18 and is further constructed and arranged to snap the blade 22 back down into engagement with the second contact 20 to thereafter complete the by-pass circuit through the third and fourth contacts 24 and 26 when a speed of approximately 60 M. P. H. is exceeded. It will be seen that such an arrangement permits the third and fourth contacts 24 and 26 to be brought together slowly without arcing, inasmuch as the by-pass circuit will be open at the time the contacts 24 and 26 are brought together, and that the by-pass circuit will be closed by a snap action of the same switch blade 22 to thereafter prevent the fourth gear arrangement from being taken out of operation. The snap action of the blade 22 from the first contact 18 to the second contact 20 is so fast that the momentary interruption of electrical flow through the solenoid 10 is not sufficiently long to produce an actuation of the solenoid 10. The switch structure A shown in the drawing employs a minimum of parts which in themselves are extremely simple and easily manufactured; and for a more complete understanding of the construction and operation of the embodiment shown reference may now be had to Figure 1 of the drawings.

The three-stage governor switch shown in Figure 1 generally comprises a body member 28 having a rotatable shaft 30 journalled in an opening of the body member 28 by suitable sleeve bearings 32 and 34. The rotatable shaft 30 carries a pair of what are commonly called flyball weights 36 adapted to provide an axial movement to a control member B which in turn actuates the three-stage electrical snap acting structure C mounted on the top cover plate 38 of the governor.

Flyball weights 36 are formed from a pair of generally square metal pieces which are pivoted as at 40 and 42 to the upright legs 44 of a channel section 46 which is riveted to a flange 48 on the upper end of the rotatable shaft 30. Each of the flyball weights 36 are provided with an inwardly facing slot 50 adapted to receive opposite sides of a flange 52 carried by the axially positionable stem 54 of the governor structure. The lower end of the stem 54 is provided with a reduced diameter section 56 which projects down into a bore 58 in the upper end of the rotatable shaft 30, and which section carries a pair of spaced sleeves 60 and 62 positioned in the bore 58. The lower sleeve 62 is suitably fixed to the lower end of the stem section 56, and the upper sleeve 60 is biased into engagement with a shoulder 64 of the stem 54 as by a coil spring 66 interpositioned between the flanged sleeves 60 and 62. The outer edges of the flanged sleeves 60 and 62 are adapted to position the stem 54 within the bore, and are retained within the bore by means of inwardly projecting portions of the channel section 36 which overlie the upper end of the sleeve 60. The botom end of the channel section 46 is journalled or adapted to ride on the upper end of the sleeve bearing 32; and the entire rotatable assembly is locked in place by means of a nut 68 threaded onto the lower end of the rotatable shaft 30 and tightened into engagement with a shoulder (not shown) to provide clearance with respect to the lower end of the sleeve bearing 34.

The snap acting switch structure C that is mounted on the top cover plate 38 generally comprises first and second generally vertically movable support members or pins 70 and 72 respectively, and the switch blade 22 previously referred to which is positioned at generally right angles to the pins 70 and 72. The switch blade 22 is formed from a generally rectangular shaped stamped section of spring material—the center portion of which is stamped to provide an arcuately bowed spring section 74. One end of the central opening 76 in the blade is slipped over the first support member 70 with the end closure portion 78 of the blade fitted into a suitable recess or groove formed in the outer edge of the first support member 70. The other end of the blade 22 is positioned between the first and second electrical contacts 18 and 20 previously referred to, and the blade is held in place by wedging the free end of the bowed spring section 74 into a receiving groove formed in the second support member or pin 72. The compressing forces thus produced in the spring section 74 provide tension in the blade section 22 which snaps the blade in engagement with either of the contacts 18 and 20 depending upon the relative position of the blade and spring portions 22 and 74 respectively. For the purposes of understanding the snap action of the switch, the integral connection between the spring section 74 and the blade 22 may be thought of as a pivotal one. With this assumption made, the spring may be considered to act on a line of force through its opposite end portions, and the blade 22 may be thought of as exerting tension on the line of force passing through its end portion 78 and its connection with the spring section 74. In the normal position of the switch shown in Figure 1, the free end of the spring 74 will be positioned by the second support member 72 above the blade 22 such that the line of force of the spring is above the line of force for the blade. The line of force for the spring, therefore, forces the blade downwardly into engagement with the second contact 20. Should the positions of the line of force be reversed, such that the line of force of the spring is beneath the line of force for the blade, an upper component will be produced upon the blade 22 forcing it into engagement with the upper or first contact 18.

The first support member or pin 70 is integrally formed as an integral part of the control member B. One end of the control member B is abutted by the top end of the vertically movable stem 54, and the other end of the control member B is pivotally supported by the cover plate 38. The pivotal connection with the cover plate is formed by means of a pair of laterally projecting knife edge projections 80 and 82 carried by the control member B and which are positioned behind a downward projection 84 formed on a plate 86 which is riveted to the under side of the cover plate 38.

The knife edge projections 80 and 82 are held in engagement with the downward projection 84 by means of the compressive forces in the spring section 74.

The control member B is biased downwardly into engagement with the top end of the vertically movable stem 54 by means of a coil spring 88—the lower end of which carries a plug 90 which abuts the top end of the first pin 70, and the top end of which is carried by an adjustment screw 92 threaded into the cover plate 38. The second pin 72 is also adapted for vertical movement and is formed by means of a headed pin the lower end of which is adapted to be engaged by the control member B. The upper end of the second pin 72 is received in a guide hole 94 formed in the plate 86; and the head 96 of the pin is held down into engagement with the top of the plate 86 by means of a coil spring 98 interpositioned between the plate 86 and the cover plate 38.

The three-stage snap acting switch mechanism C further includes the third and fourth contacts 24 and 26 respectively—the function of which has been previously described. The third contact 24 is mounted on one end of a flexible blade 100 made of an electrical conducting ma-

terial and the other end of which is riveted by the second contact 20 to a rigid piece of insulating material 102. The piece of insulating material 102 is in turn riveted to and supported by a downwardly bent portion 104 of the stamped plate 86 that is carried by the cover member 38. The third contact 24 is spaced above the fourth contact 26 by a generally predetermined distance when the control member B is in its normal or at rest position; and the fourth contact 26 is formed on one end of a stamped blade 106 which is fastened as by machine screw 110 to a second terminal 108 that is carried by the cover plate 38. The stamped blade 106 provides a spring action which biases itself downwardly against a strip of insulating material 112 that is riveted to the control member B by means of a headed button 114.

During non-rotating periods or during very slow rotating speeds of the shaft 30, the parts of the switch will be in the position shown in Figure 1 of the drawings. In this position, the line of force for the spring 74 will be above the line of force for the blade 22 causing the blade to be held in abutment with the lower or second contact 20 of the switch. Rotation of the shaft 30 causes centrifugal force of the flyball weights 36 to produce a rocking action of the weights about the pins 40 and 42 which in turn causes the flange 52 of the stem 54 to be moved upwardly. Sufficient clearance will normally be provided between the upper sleeve 60 and the inner portion of the channel section 46 to prevent the spring 66 from being compressed during the initial stage of the switches operation. Downward force upon the stem 54 will be exerted solely by the coil spring 88; and this of course can be adjusted to provide a predetermined force which will be overcome by the force developed by the rotating flyball weights 36 at a predetermined speed of rotation. In the switch shown in the drawing, this will occur at a vehicle speed of approximately 28 M. P. H.; and when the vehicle reaches a speed of approximately 30 M. P. H., the control member B will move the first pin 70 upwardly sufficiently to move the line of force for the blade 22 above the line of force for the spring 74 to thereby cause the spring 74 to snap the blade into engagement with the first contact 18. As previously indicated the relative position of the parts when in their at rest position may be seen in Figure 1 of the drawings, and the relative position of the switch parts when in the switches second stage of operation may be seen in Figure 5 of the drawings. In the second stage of switch operation as seen in Figure 5, electrical energy flows through the solenoid 10 and kickdown switch 16 to the terminal 116, and thence through contacts 18 and blade 22 to the grounded structure of the switch. This will normally bring the fourth gear arrangement of the overdrive transmission into operation; and should the operator desire to cause the transmission to revert back into its third gear arrangement, a depression of the accelerator pedal to the floor will open kickdown switch 16 to automatically produce the gear shifting operation.

At speeds above approximately 30 M. P. H. the upper sleeve 60 will be in engagement with the channel section 46, and gradually increasing the vehicle speeds will thereafter cause the stem 54 to move upwardly to effect compression of the coil spring 66. Upward movement of the stem 54 will, of course, move the control member B upwardly and at a speed of approximately 50 M. P. H. the fourth contact 26 will move into abutment with the third contact 24 as will be seen in Figure 6 of the drawings. At this stage of the switches operation the blade 22 will still be in engagement with the upper contact 18 and a slight amount of clearance will still exist between the second support member or pin 72 and the movable control member B. Shortly thereafter, the control member B abuts the second pin 72 and moves both of the support pins 70 and 72 upwardly. By reason of the manner in which the movable control member B

is pivoted with respect to the support pins 70 and 72, continued upward movement of the control member B causes the second pin 72 to move upwardly at a faster rate than is the first support pin 70. When a vehicle speed of approximately 60 M. P. H. is reached, the notch in the pin 72 which receives the end of the springs 74 is moved to a position above the blade 22 as will be seen in Figure 7 of the drawings. This, of course, now positions the line of force for the spring above the line of force for the blade, and the blade 22 snaps downwardly out of engagement with the first contact 18 into engagement with the second contact 20. This in effect opens the circuit with respect to the kickdown switch 16 and establishes the previously referred to by-pass circuit through contacts 26, 24, and 20, and the switch blade 22. The movement of the contact 26 into engagement with the contact 24 is normally a gradual one; and by reason of the fact that contact 20 is open when the contacts 24 and 26 are closed, no arcing occurs at the time that contacts 24 and 26 engage each other. The switch therefore has the advantage of controlling two circuits with a single snap-acting mechanism in such manner that the amount of arcing is reduced to a practical minimum in each of the circuits controlled. At a vehicle speed of approximately 80 M. P. H. the sleeve 62 moves into abutment with the sleeve 60 to thereafter prevent further vertical movement of the control member B.

While the invention has been set forth in considerable detail, I do not wish to be limited to the particular constructions shown and described; it is my intention to cover hereby all novel adaptations, modifications, and uses thereof which come within the practice of those skilled in the art to which the invention relates.

I claim:

1. In a three-stage governor switch: first and second generally stationary contacts spaced apart in a first direction; a switch blade one end of which is positioned between said first and second contacts; third and fourth contacts normally spaced apart in said first direction and each being movable in said first direction; a control member movable generally in said first direction, to force said fourth contact into engagement with said third contact, snap action means operatively connecting said control member and said switch blade for snapping said blade out of engagement with said second contact into engagement with said first contact upon movement of said control member in said first direction, said movement taking place prior to the time that said movement of said control member causes said fourth contact to engage said third contact; an electrical conductor connecting said second and third contacts; and means causing said snap action means to snap said blade back into engagement with said second contact upon continued movement of said control member in said first direction after having caused said third and fourth contacts to engage each other.

2. In a three-stage governor switch: first and second generally stationary contact surfaces spaced apart in a first direction; a switch blade one end of which is positioned between said first and second contacts for alternate abutment with said first and second contacts; a control member movable generally in said first direction from a normal position; a fourth contact surface movable in said first direction from its normal position by said control member; a flexible member supporting a third contact surface a generally predetermined distance in said first direction from said normal position of said fourth contact surface said third contact surface being electrically connected to said second contact surface; snap action means operatively connecting said control member and said switch blade for snapping said blade from said second contact surface to said first contact surface as said control member is moved in said first direction from its normal position, the normal spacing

of said third and fourth contact surfaces being such that movement of said control member in said first direction causes said snap acting means to move said blade into engagement with said first contact surface prior to the time that said control member moves said fourth contact surface into engagement with said third contact surface; and means causing continued motion of said control member in said first direction after said third and fourth contact surfaces are engaged to snap said blade back into engagement with said second contact surface.

3. In a three-stage governor switch: first and second generally stationary contact surfaces spaced apart in a first direction; a switch blade one end of which is positioned between said first and second contacts for alternate abutment with said first and second contacts; a control member movable generally in said first direction from a normal position; a fourth contact surface movable in said first direction from its normal position by said control member; a flexible member supporting a third contact surface a generally predetermined distance in said first direction from said normal position of said fourth contact surface, said flexible member being electrically connected to said second contact surface and being rigidly supported adjacent said second contact surface; snap action means operatively connecting said control member and said switch blade for snapping said blade from said second contact surface to said first contact surface as said control member is moved in said first direction from its normal position, the normal spacing of said third and fourth contact surfaces being such that movement of said control member in said first direction causes said snap acting means to move said blade into engagement with said first contact surface prior to the time that said control member moves said fourth contact surface into engagement with said third contact surface; and means causing continued motion of said control member in said first direction after said third and fourth contact surfaces are engaged to snap said blade back into engagement with said second contact surface.

4. In a three-stage governor switch: a body member having a longitudinally extending axis; first and second pins movable in generally axially extending directions; first and second axially spaced contact surfaces positioned to the other side of said second pin from said first pin, said first contact surface being spaced axially upwardly of said second contact surface; a switch blade pivotally supported on one of said pins and extending between said first and second contact surfaces; an overcenter spring biased between the other of said pins and a portion of said blade adjacent said contact surfaces to normally produce lines of force for the spring and blade which are one above the other to normally hold the blade in engagement with said second contact surface; a control member which is movable generally axially upwardly from its normal position; a fourth contact surface which is movable axially upwardly by said control member from its normal position; a flexible electrical conductor having one end generally rigidly supported adjacent said second contact surface and supporting a third contact surface a generally fixed distance axially upwardly from the normal posititon of said fourth contact surface; said control member being so constructed and arranged that axially upward movement from its normal position moves said first pin sufficiently to cause the relative positions of the lines of force to reverse to snap said blade into engagement with said first contact surface before it moves said fourth contact surface into engagement with said third contact surface, and that still further axially upward movement causes said third and fourth contacts to engage and said second pin to be moved sufficiently to cause the lines of force to revert back to their original relative positions and the blade to snap into engagement with said second contact surface subsequent to the time that the third and fourth contacs are engaged.

5. In a three-stage governor switch: a body member having a longitudinally extending axis; first and second pins movable in generally axially extending directions; first and second axially spaced contact surfaces positioned to the other side of said second pin from said first pin, said first contact surface being spaced axially upwardly of said second contact surface; a switch blade pivotally supported on said first pin and extending between said first and second contact surfaces; an overcenter compression spring biased between said second pin and a portion of said blade adjacent said contact surfaces to normally produce a line of force for the spring which is axially upwardly of the line of force for the blade to hold the blade in engagement with said second contact surface; a control member which is movable generally axially upwardly from its normal position; a fourth contact surface which is movable axially upwardly by said control member from its normal position; a flexible electrical conductor having one end generally rigidly supported adjacent said second contact surface and supporting a third contact surface a generally fixed distance axially upwardly from the normal position of said fourth contact surface; said control member being so constructed and arranged that axially upward movement from its normal position moves said first pin sufficiently to cause the line of force for the blade to move axially upwardly of the line of force for the spring to snap said blade into engagement with said first contact surface before it moves said fourth contact surface into engagement with said third contact surface, and that still further axially upward movement causes said third and fourth contacts to engage and said second pin to be moved thereafter sufficiently to bring the line of force for the spring above the line of force for the blade to cause the blade to snap into engagement with said second contact surface subsequent to the time that the third and fourth contacts are engaged.

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