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TRANSMISSION NEUTRAL SWITCH

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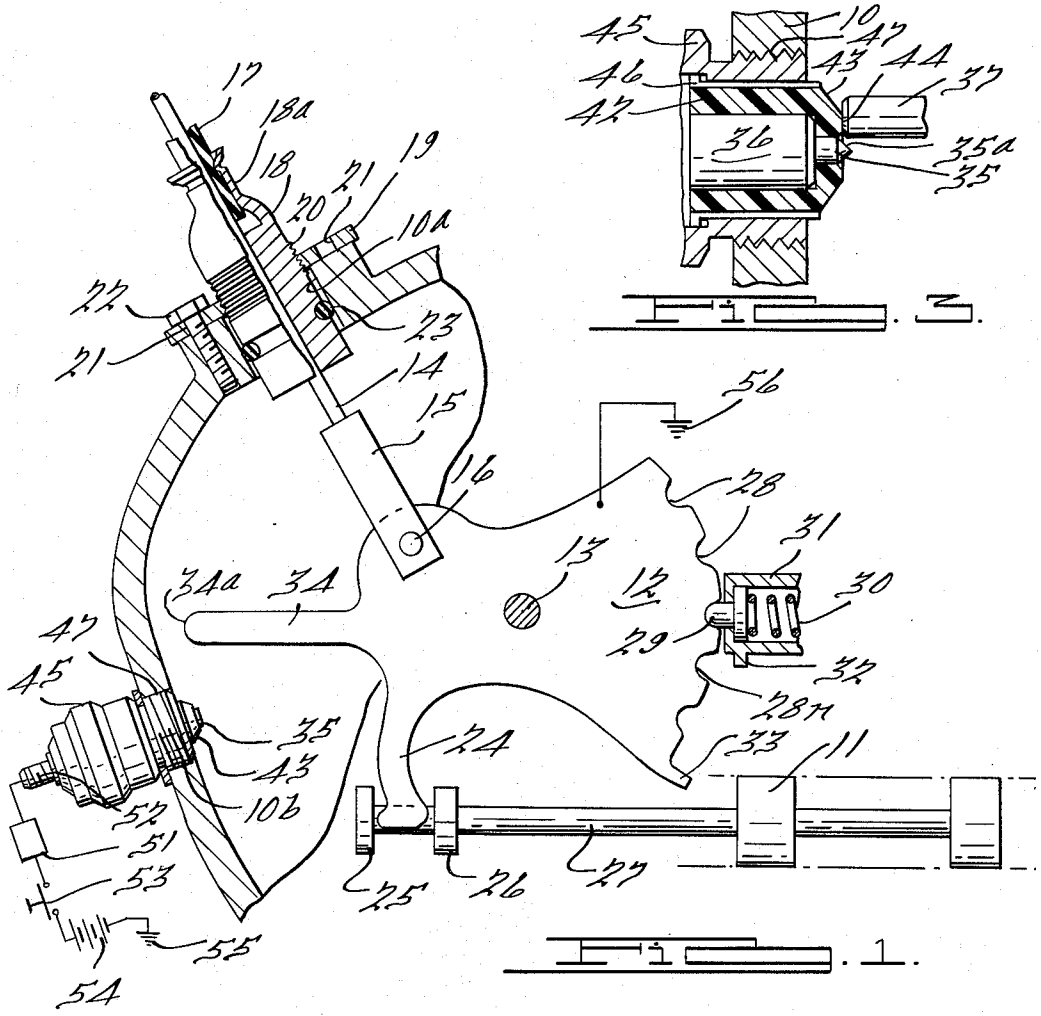

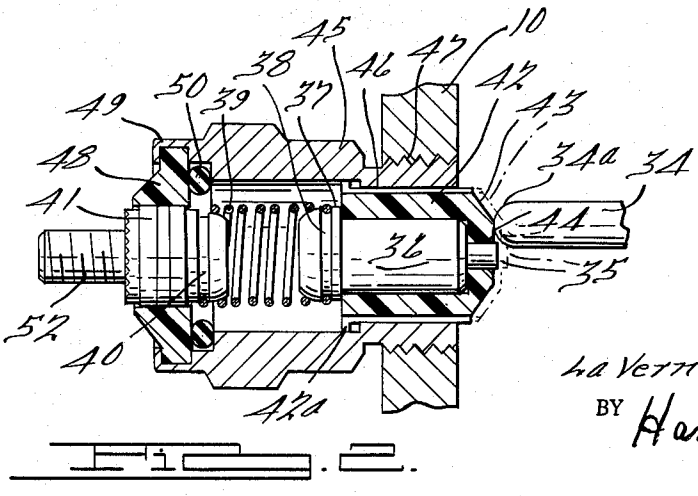

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TRANSMISSION NEUTRAL SWITCH

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This invention relates to improvements in an automobile transmission neutral switch for indicating when the transmission is in its neutral condition.

It has been conventional to provide a transmission neutral switch in the electric starting circuit for an automotive vehicle to prevent starting of the vehicle engine unless the automatic transmission is in its neutral condition. Heretofore, difficulty has been encountered in precisely indexing the electrical contact points of the switch with the transmission mechanism, so that on too many occasions the contact points enabled closing of the engine starting circuit when the transmission was not actually in neutral, i.e., when the transmission was in an operative condition for driving the vehicle in a forward or reverse gear.

An important object of the invention has been to provide an improved neutral switch mechanism cooperable with the transmission to enable starting of the vehicle engine only when the transmission is in neutral, which is particularly simple and economical to manufacture and assemble, and which readily accommodates the inevitable stack-up of production tolerances in the transmission and switch mechanism, yet assures critical indexing of the contact points of the switch when the transmission is in its neutral position or condition.

Another and more specific object is to provide such a mechanism comprising a pivotal electrical contact finger adapted to swing to various positions associated with the various operating conditions of the transmission, including the neutral condition, and having a rounded cam surface at its swinging end. A second contact element comprises an axially shiftable plunger having its axis aligned radially with the pivotal finger when the latter is in the neutral position and having a coaxial tip yieldably urged radially, i.e. axially of the plunger, into electrical contact with the rounded cam surface of the finger. A shield of electrical insulating material secured around the plunger to move therewith provides an insulating cam surface extending transversely of the axis of the plunger adjacent the end of the tip which projects a predetermined distance beyond the insulating cam surface amounting to between approximately .001 and .003".

The parts are arranged so that as the pivotal finger swings toward a position of alignment with the axis of the plunger, its rounded cam surface will engage the insulating cam surface and force the latter and plunger axially away from the finger. Accordingly, immediately before the rounded cam surface of the finger engages the tip of the plunger to establish electrical connection therewith, a predetermined spacial relationship will exist between the plunger and finger regardless of variations in the dimensions of the parts resulting from ordinarily encountered production tolerances. In accordance with the aforementioned spacial relationship, the rounded cam surface of the finger will extend axially of the plunger and overlap the plunger tip a distance predetermined by the extent that the plunger tip projects axially beyond the insulating cam surface. Thus the electrical contact between the plunger tip and the rounded cam surface of the pivotal finger will be made adjacent the extremities of these elements, rather than at lateral portions thereof.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this

specification wherein like reference characters designate corresponding parts in the several views.

FIGURE 1 is a somewhat schematic elevational view of a transmission control mechanism and neutral switch embodying the present invention.

FIGURE 2 is an enlarged fragmentary view similar to FIGURE 1 but showing the switch in longitudinal section.

FIGURE 3 is a view similar to FIGURE 2, but illustrating a modification of the invention.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to FIGURES 1 and 2, a particular embodiment of the present invention is illustrated by way of example in an automobile transmission mechanism having a housing **10** which contains an axial shiftable spool valve **11**. The latter is shiftable to various axial positions to control the flow of hydraulic actuating fluid so as to effect a corresponding shifting of the transmission to its various operating positions. The cooperable relationship between the spool valve **11** and the remaining portions of the transmission may be conventional and are accordingly not illustrated in detail.

The spool valve **11** is controlled by operation of a pivotal lever **12** pivotally connected at **13** to a fixed portion of the housing **10**. A Bowden wire or cable **14** having one end connected to a terminal **15**, which in turn is pivotally connected at **16** to lever **12** to pivot the same, extends through an opening **10***a* in a thickened portion of the housing **10** and is connected at its outer end with a manually actuated mechanism under the control of the vehicle operator. The wire **14** is encased with a flexible sheath **17** which extends into one end of a tubular guide **18**, the latter also is confined within the hole **10***a* and carries the wire **14** shiftably coaxially therein.

A nut **19** is adjustably screwed on a threaded portion **20** of the guide **18** and is provided with a plurality of adjustment holes **21**, at least one of which is selectively indexed with a mating screw hole in the housing **10**, the assembly of the guide **18**, nut **19**, and housing **10** being secured together by one or more bolts **22**. An annularly extending axial flange **18***a* of the guide **18** overlaps the inner end of sheath **17** and is crimped annularly thereinto to effect a fluid tight seal therewith. Extending around the guide **18** within the hole **10***a* is a fluid sealing O-ring **23**.

A swinging arm **24** of the lever **12** terminates in a ball end confined between stops **25** and **26** secured to the end of plunger **27** for the spool valve **11** to actuate the latter in accordance with pivoting of lever **12**. Arranged annularly about the axis of pivot **13** are a plurality of detent notches **28** including a neutral detent notch **28***n*. A radially shiftable detent plunger **29** is arranged to be selectively indexed with the notches **28** and is urged into the detent position by spring **30** confined within a fixed housing **31** suitably secured within housing **10**. Stops **32** and **33** on the housing **31** and lever **12**, respectively, limit pivotal movement of lever **12** in one direction.

Also integral with lever **12** is a swinging finger **34** which terminates in a rounded electrical contact tip or cam surface **34***a* adapted to sweep transversely across a mating electrical contact tip **35** of a switch plunger **36** and to register therewith when the plunger **29** is indexed within notch **28***n* and the transmission is at its neutral condition. The plunger **36** is of enlarged diameter with respect to the tip **35** and terminates oppositely from the tip

35 in an enlarged annular spring retaining stop 37 and a spring retaining groove 38. Coil spring 39 extends coaxially of the plunger 36 to urge the latter rightward in FIGURE 2 and has one end confined within groove 38. The opposite end of spring 39 is confined within a groove 40 in a fixed plug 41.

A shield 42 of electrical insulating material is secured around plunger 36 and tip 35 to move therewith and provides an annular cam surface comprising a conically tapered portion 43 and an annular plane portion 44 extending perpendicularly to the axis of plunger 36 and tip 35. The latter extends a predetermined distance axially end-wise beyond the plane surface 44, which distance is critical and is closely maintained within approximately .001 and .003 inch. A generally tubular switch housing 45 contains the plunger combination 36–42 and spring 39 and is electrically insulated from the plunger 36 by means of the shield 42. A plurality of axially extending grooves 46 in the periphery of shield 42 enables the free interchange of hydraulic fluid to and from the interior of housing 45 during operation of plunger 36–42. Rightward movement of plunger 36–42 is limited by annular stop 42*a* of shield 42 engaging a portion of housing 45.

The portion of housing 45 around shield 42 is threaded at 47 and screwed into a mating hole 10*b* within housing 10.

A second fixed shield 48 of electrical insulating material is secured coaxially around plug 41 in fluid sealing relationship therewith and insulates the latter from housing 45. A flange 49 of the latter housing extends tightly around the exterior of shield 48 and is suitably secured thereto. An O-ring seal 50 is confined between portions of housing 45 and shield 48 to provide a fluid seal therebetween.

An electrical starting circuit 51 which may include a starting relay is schematically indicated in FIGURE 1 and is electrically connected with a contact terminal 52 of plug 41. The starting circuit 51 energizes the electrical starting motor for the vehicle engine and may extend through a suitable starting switch 53 and energy source 54 to ground at 55. The circuit is completed through contact 52, plug 41, spring 39, plunger 36, tip 35, and thence through finger 34 and lever 12 to ground at 56 when lever 12 is in the neutral position.

When cable 14 is actuated to swing lever 12 from any operating position to the neutral position whereat notch 28*n* is indexed with plunger 29, the rounded contact tip 34*a* will swing into alignment with contact 35. As indicated in FIGURE 2, as the tip 34*a* engages cam surface 43, the plunger 36 and tip 35 will be shifted axially leftward. Thereafter the rounded tip 34*a* will ride along the plane cam surface 44, whereby a predetermined spacial relationship will be established between tip 35 and contact surface 34*a* of the finger 34 regardless of production variation in the dimensions of the parts involved or in the location of pivot 13, or of other dimensional variations in the mechanism. By virtue of the rounded cam surface 34*a* and the dimensionally controlled extension of tip 35 beyond the insulated cam surface 44, contact between tips 35 and 34*a* will not be made until the lever 12 is either at or sufficiently close to its neutral position that the transmission under the control of spool valve 11 will be only at its neutral position. In other words, regardless of production variations in the dimensions of the parts involved, immediately before contact is made between tips 34*a* and 35, the tip 34*a* and 35, the tip 34*a* will overlap tip 35 axially a carefully predetermined distance amounting to between approximately .001 and .003".

Tip 34*a* preferably carries the rounded cam surface. However, either tip 34*a* or 35, or both, may be rounded or tapered as desired. As illustrated in FIGURE 3, the tip 35 is conically tapered at 35*a*, the taper extending below the surface 44 to prevent contact between finger 34 and tip 35 until these elements are in substantially

radial alignment with respect to the pivot 13. In other respects, the embodiment illustrated in FIGURE 3 obtains the advantages and operates in the manner of the modification illustrated in FIGURE 2.

I claim:

1. In combination, an automobile engine transmission having various operating positions including a neutral position, an operative electrical engine starting circuit having first and second electrical contact tips and operative to enable starting of said engine when said tips are in electrical contact with each other, a pivotal member carrying said second tip for swinging the latter into a position of radial alignment with said first tip and the axis of swinging, resilient means yieldingly urging said first tip radially toward said axis and into said electrical contact when said tips are in said radial alignment, means operatively connecting said transmission and member to swing the latter in synchronism with the actuation of said transmission to its operating positions throughout a comparatively large arc with respect to the arc defining said position of radial alignment and to swing said second tip into said position of radial alignment upon movement of said transmission to its neutral position, and means for moving said first tip radially into predetermined spatial relationship with respect to said second tip as the latter approaches said position of radial alignment comprising a cam surface of electrical insulating material fixed with respect to one of said tips to move therewith and extending therefrom transversely of the radius from said axis to said one tip to engage the other of said tips and move said first tip radially from said axis in opposition to said resilient means upon swinging of said second tip into electrical contact with said first tip, said one tip projecting radially beyond said cam surface a small closely dimensioned distance, thereby to effect a closely dimensioned overlap of said tips equal to said distance immediately prior to said electrical contact therebetween, at least one of said tips having an endwise tapered cam surface engageable by the other of said tips to move said first tip radially and reduce said overlap upon swinging of said second tip into said electrical contact with said first tip.

2. In the combination according to claim 1, the dimension of said overlap being between values on the order of about .001" and .003".

3. In combination, an automobile engine transmission having various operating positions including a neutral position, an operative electrical engine starting circuit having first and second electrical contact tips and operative to enable starting of said engine when said tips are in electrical contact with each other, a pivotal member carrying said second tip for swinging the latter into a position of radial alignment with said first tip and the axis of swinging, resilient means yieldingly urging said first tip radially in one direction toward said axis and into said electrical contact when said tips are in said radial alignment, means operatively connecting said transmission and member to swing the latter in synchronism with actuation of said transmission to its operating positions throughout a comparatively large arc with respect to the arc defining said position of radial alignment and to swing said second tip into said position of radial alignment upon movement of said transmission to its neutral position, and means for moving said first tip radially into predetermined spatial relationship with respect to said second tip as the latter approaches said position of radial alignment comprising a cam surface of electrical insulating material fixed in accurately dimensioned spatial relationship with respect to said first tip to move therewith and extending therefrom transversely of the radius from said axis to said first tip and having a portion inclined in said one direction toward said radius to engage said second tip and move said first tip radially from said axis in opposition to said resilient means into said accurately dimensioned spatial relationship with respect to

said first tip upon swinging of said second tip into electrical contact with said first tip.

4. In combination, an operative electrical circuit having first and second electrical contact tips, a pivotal member carrying said second tip for swinging the latter into a position of radial alignment with said first tip and the axis of swinging, resilient means yieldingly urging said first tip radially toward said axis and into said electrical contact when said tips are in said radial alignment, and means for moving said first tip radially into predetermined spatial relationship with respect to said second tip as the latter approaches said position of radial alignment comprising a cam surface of electrical insulating material fixed with respect to one of said tips to move therewith and extending therefrom transversely of the radius from said axis to said one tip to engage the other of said tips and move said first tip radially from said axis in opposition to said resilient means upon swinging of said second tip into electrical contact with said first tip, said one tip projecting radially beyond said cam surface a small closely dimensioned distance, thereby to effect a closely dimensioned overlap of said tips equal to said distance immediately prior to said electrical contact therebetween, at least one of said tips having an endwise tapered cam surface engageable by the other of said tips to move said first tip radially and reduce said overlap upon swinging of said second tip into said electrical contact with said first tip.

5. In the combination according to claim 4, the dimension of said overlap being between values on the order of about .001" and .003".

6. In combination, an operative electrical circuit having first and second electrical contact tips, a pivotal member carrying said second tip for swinging the latter into a position of radial alignment with said first tip and the axis of swinging, resilient means yieldingly urging said first tip radially in one direction toward said axis and into said electrical contact when said tips are in said radial alignment, and means for moving said first tip radially into predetermined spatial relationship with respect to said second tip as the latter approaches said position of radial alignment comprising a cam surface of electrical insulating material fixed in accurately dimensioned spatial relationship with respect to said first tip to move therewith and extending therefrom transversely of the radius from said axis to said first tip and having a portion inclined in said one direction toward said radius to engage said second tip and move said first tip radially from said axis in opposition to said resilient means into said accurately dimensioned spatial relationship with respect to said first tip upon swinging of said second tip into electrical contact with said first tip.

7. In the combination according to claim 6, said first tip projecting radially beyond said cam surface a small closely dimensioned distance, thereby to effect a closely dimensioned overlap of said tips equal to said distance immediately prior to said electrical contact therebetween, at least one of said tips having an endwise tapered cam surface engageable by the other of said tip to move said first tip radially and reduce said overlap upon swinging of said second tip into said electrical contact with said first tip.

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