Jan. 13, 1970 R. C. CARLSON 3,489,867

PUSHBUTTON SELECTOR SWITCH

Filed Nov. 4, 1968 3 Sheets-Sheet 1

Fig. 1.

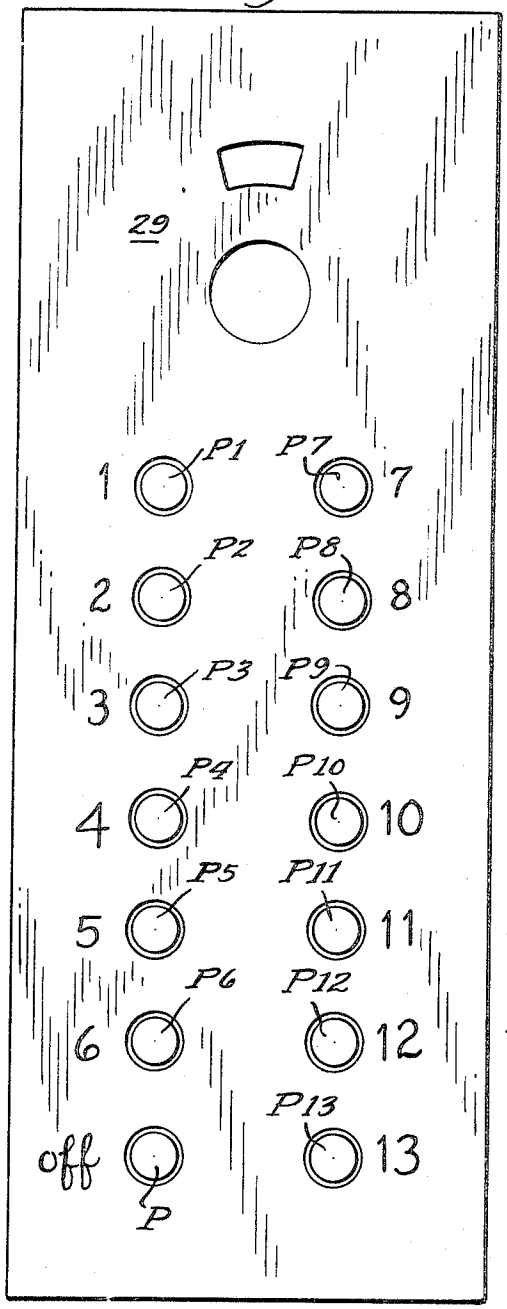
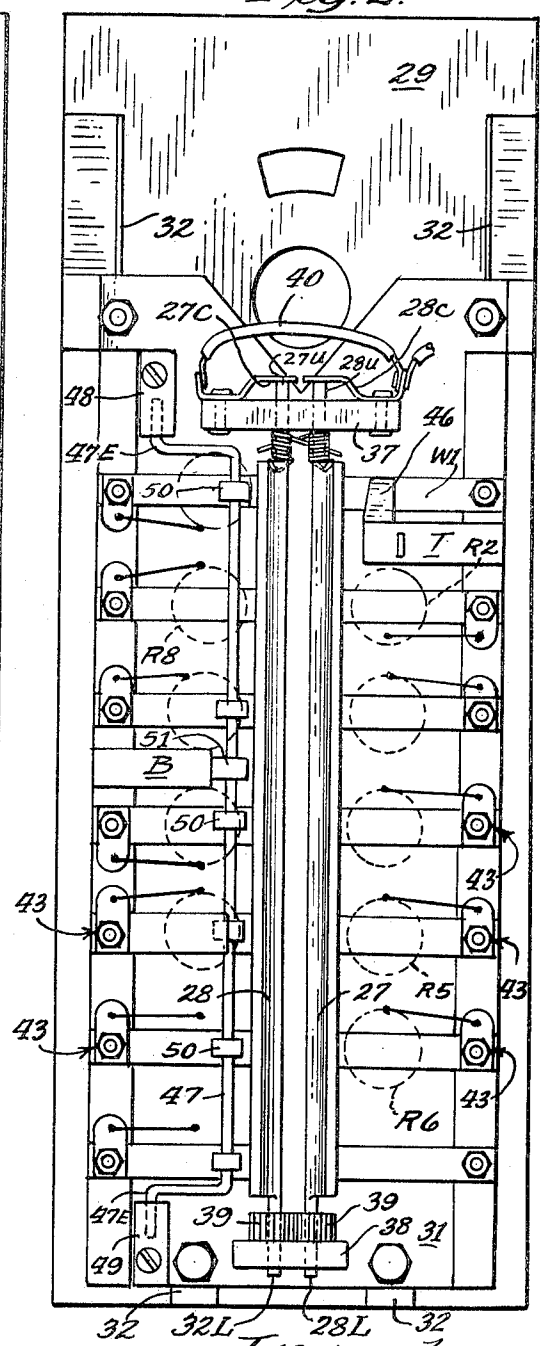



Fig. 2.




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Fig. 3.

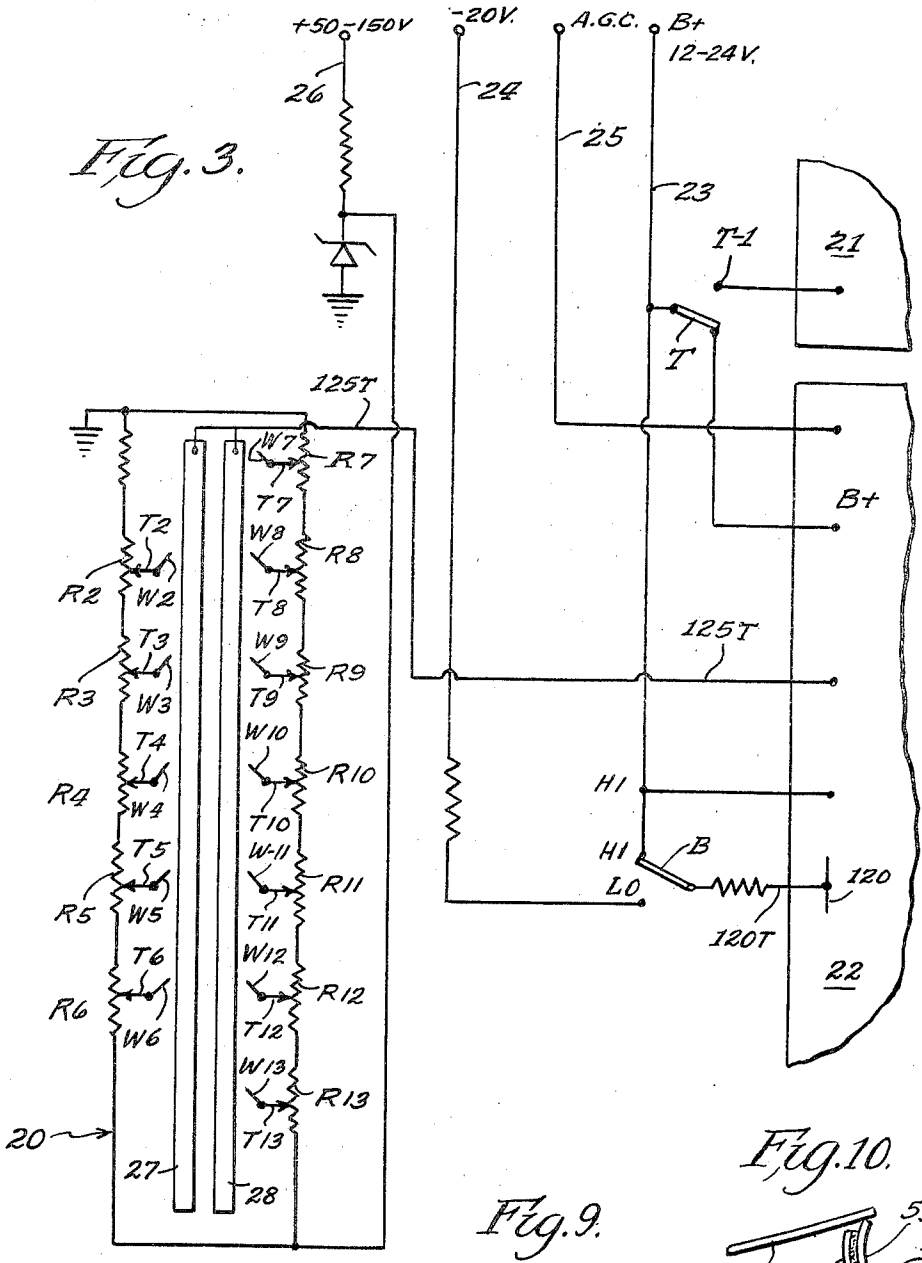



Fig. 10.

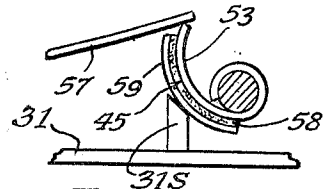



Fig. 9.

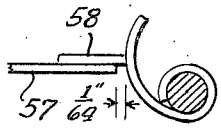
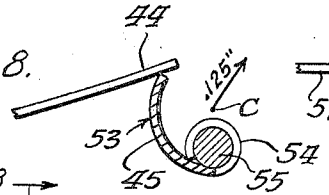



Fig. 8.



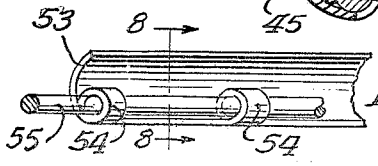




Fig. 7.

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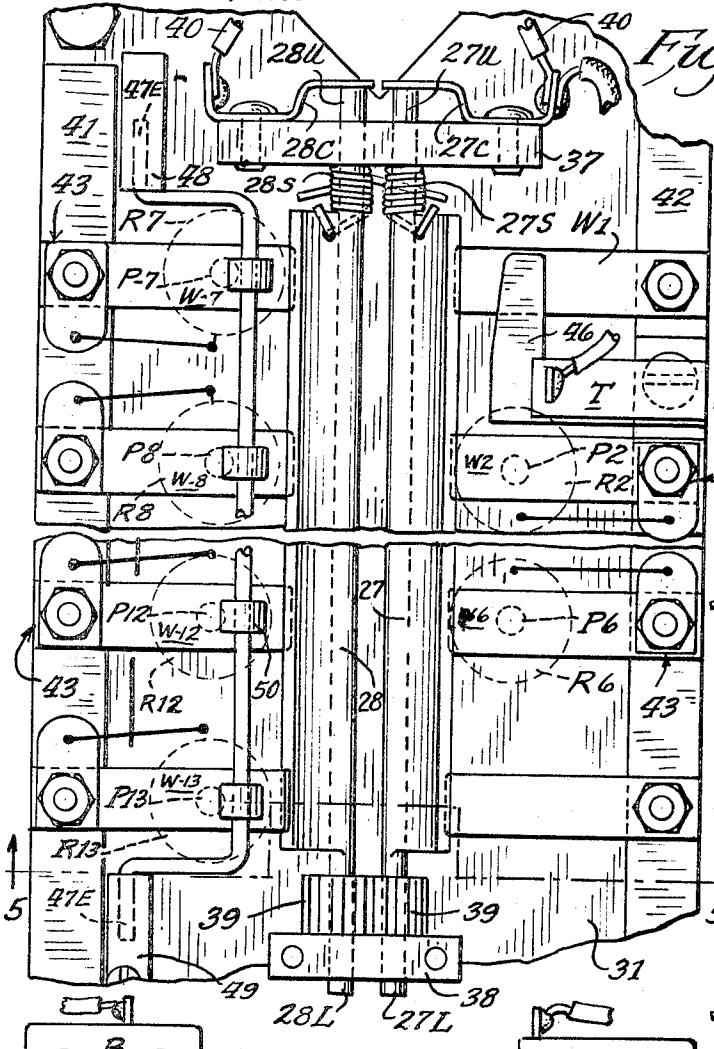



Fig. 4.

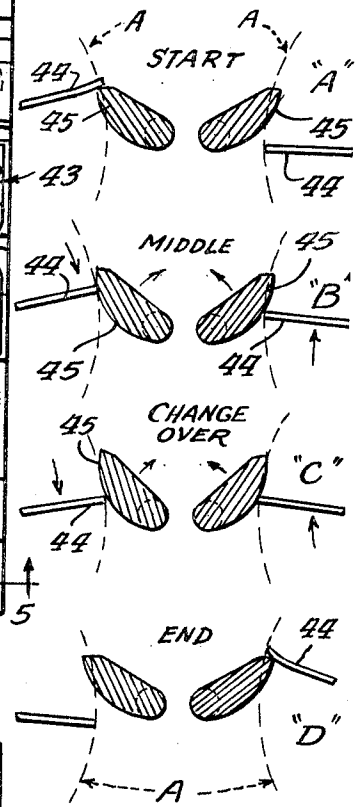



Fig. 6.

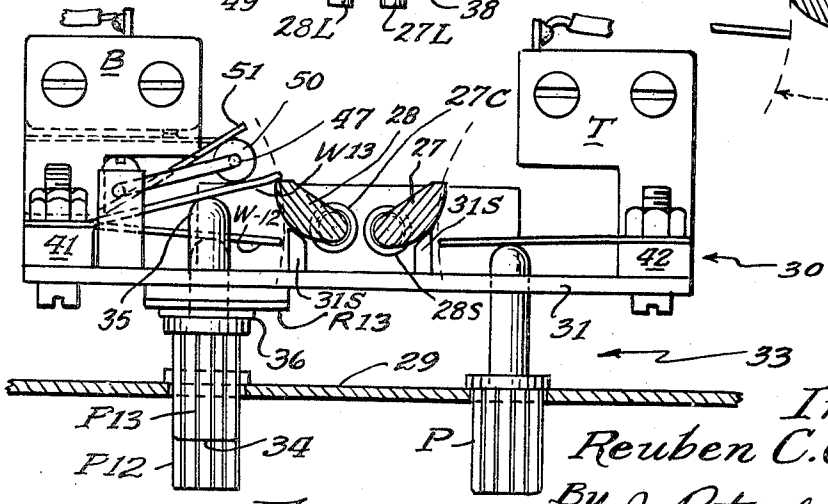



Fig. 5.

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3,489,867

# PUSHBUTTON SELECTOR SWITCH

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Int. Cl. H01h 9/26
U.S. Cl. 200—5 9 Claims

## ABSTRACT OF THE DISCLOSURE

A latch bar and wiper leaf structure is shown in a selector switch arrangement adapted for pushbutton actuation and connected to control voltage tuning and band switching circuitry of a solid state TV tuner. The switch structure utilizes a pair of jointly swingable side-by-side mounted latch bars, each having an elongated cam portion characterized by a rounded lobe profile. A separate set of wiper leaves is spaced along each latch bar, each wiper leaf having a free end swinging in cantilever fashion along a travel arc that intersects the profile of the corresponding latch bar and cams the latch bars through joint rotation to accommodate movement of the wiper leaf from switch-open position to switch-closed position.

## BACKGROUND OF THE INVENTION

There is a need for an improved pushbutton selector switch and more particularly for a selector switch mechanism for use with multi-channel circuitry such as is employed in solid state television tuner circuits of the type disclosed in Gossard et al. application Ser. No. 671,011, filed Sept. 27, 1967, and entitled "Solid State Television Tuner." Such a tuner requires the application of voltages of various levels predetermined in accordance with the desired frequency or channel and it requires a separate switching arrangement for control of band switching.

Various types of pushbutton switches are known in the art, these being widely used for automobile radios and similar applications. However, there in an important need for a simple reliable and economical selector switch which can be depended upon for thousands of cycles of service-free operation over a useful life of ten years and more.

## SUMMARY OF THE INVENTION

This invention relates to a selector switch mechanism which is suitable for actuation by pushbuttons and which eliminates the need for and the operating difficulties associated with pushbutton switches that utilize a sliding latch plate.

In a selector switch constructed in accordance with this invention, an improved mechanical movement includes a wiper leaf having a resiliently swingable contact portion, an actuator to deflect the wiper leaf to swing the contact portion thereof through a predetermined arc, a latch bar having a rounded-lobe cam portion facing in opposed relation to the arc of travel of the wiper leaf, and mounting means for the latch bar including resilient means urging the same to a normal position wherein the profile of the cam portion converges toward and intersects the arc of travel of the wiper leaf, thus accommodating momentary displacement of the cam portion during movement of the wiper leaf between a relatively relaxed open position spaced from the contact lobe and a relatively stressed closed position.

In the selector switch embodiment illustrated herein for use in presenting voltages of various levels to control a voltage-responsive type of solid state tuner, a pair of pivotally mounted latch bars are disposed in side-by-side spaced-apart relation and are coupled to rotate in opposite directions between an outwardly flared normal



position and a centered changeover position. The latch bars are electrically interconnected to form a common output bus that supplies tuning voltage of any selected predetermined level to the tuner to control channel selection.

In a selector switch for use with a conventional television tuner which has a low frequency band of channels (channels 2 to 6) and a high frequency band of channels (channels 7 to 13), a separate wiper leaf is provided for each channel, with the wiper leaves of the low band channel being spaced along one of the latch bars and with the wiper leaves of the high band being spaced along the other latch bar. A separate pushbutton is provided beneath each wiper leaf and is actuated to deflect the wiper leaf to swing its end portion through a travel arc that engages the rounded lobe profile of the cam portion of the corresponding latch bar and produces rotation of the latch bars until the leaf overrides the latch bar, thus allowing return of the latch bar to normal position and seating of the wiper leaf in contacting relation on the edge region of the lobe profile. When it is desired to change channels, the corresponding pushbutton is actuated to deflect its wiper leaf through a travel arc for lifting the latch bars towards changeover position with the action of the previously actuated wiper leaf in tending to return towards normal position assisting in the movement of the latch bars until the transfer point is reached at which the rising leaf swings past the latch bar and the returning leaf swings beneath it to normal position. The pushbutton actuators are captively mounted and normally held projected by the corresponding wiper leaf when it is in its relatively relaxed open position spaced from the latch bar.

Other features and advantages of the invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which show structure embodying preferred features of the present invention and the principles thereof, and what is now considered to be the best mode in which to apply these principles.

## BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings forming a part of the specification in which like numerals are employed to designate like parts throughout the same:

FIGURE 1 is a front elevational view of a selector switch unit for use with a television tuner arrangement and illustrates the mounting panel and an array of channel-selecting pushbuttons;

FIGURE 2 is a rear elevational view of the selector switch assembly of FIGURE 1 and shows the mechanical arrangement of the latch bars and wiper leaves that are controlled by the pushbuttons;

FIGURE 3 is a schematic circuit diagram showing the voltage divider circuitry that is controlled by the selector switch mechanism, and includes the connections to UHV and VHF tuner sections which are represented in block diagram form;

FIGURE 4 is an enlarged fragmentary rear elevational view further illustrating the mechanical structure of the selector switch mechanism;

FIGURE 5 is a transverse sectional view taken as indicated on the line 5—5 of FIGURE 4;

FIGURES 6A to 6D comprise a set of sequence views illustrating the action of the wiper leaves in swinging above and below the latch bars;

FIGURE 7 is a fragmentary perspective view showing an alternative form of latch bar;

FIGURE 8 is a diagrammatic fragmentary elevational view showing the rounded lobe profile of the latch bar and the relationship to the wiper leaf in greater detail;

FIGURE 9 is a diagrammatic fragmentary view similar to FIGURE 8 and showing one technique of electrically insulating the wiper leaf and cam portion during changeover; and

FIGURE 10 is a view similar to FIGURE 9 and showing another technique of electrically insulating the wiper leaf and cam portion.

## DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings for purposes of illustrative disclosure, a selector switch mechanism constructed in accordance with this invention is shown in a multichannel pushbutton-type embodiment in FIGURES 1 and 2 which has incorporated in it a voltage divider network **20** as shown schematically in FIGURE 3 for controlling the switching and voltage levels applied to a UHF tuner section **21** and a VHF tuner section **22**. As indicated previously, the VHF tuner is a voltage responsive type of solid-state circuit such as is disclosed in Gossard, et al. application Ser. No. 671,011, filed Sept. 27, 1967, and entitled Solid State Television Tuner, the disclosure of which to the extent not inconsistent herewith is specifically incorporated herein by this reference.

In the VHF tuner section **22**, the channels are arranged in a low frequency band (channels **2–6**) and a high frequency band (channels **7–13**). The VHF tuner incorporates a resonant circuit having parallel inductances arranged so that a permanent inductance is operative to determine the low frequency band and a shunt high frequency inductance is switched into operation to act in conjunction with the permanent inductance in determining the high frequency band. Thus, tuning in the low band is controlled solely by the applied voltage on line **125T** in FIGURE 3, but tuning in the high band is controlled both by the applied voltage in line **125T** and by the conventional switch B, which is operable to apply voltage of either polarity to line **120T** to feed the band switch bus **120**. For high band operation the switch B is connected to the B+ supply bus **23** whereby the shunt inductance of the VHF tuner is in circuit, while for low band operation the switch B is connected to a reverse voltage bus **24** to block out the circuit connection to the shunt inductance. A separate switch T is shown to provide overriding control in connecting the B+ supply bus **23** either to the VHF tuner section **22** or to a UHF tuner section **21** which may be of any conventional type. The switch T is operated from the channel **1** position on the selector switch mechanism as is described in detail hereinafter.

The remainder of the tuner control circuitry in FIGURE 3 includes a conventional AGC supply bus **25** and a regulated DC supply bus **26** feeding the voltage divider network **20**. The voltage divider network includes parallel branches each having series connected resistors of a variable tap type. One of the divider branches includes resistors R2 to R6 connected in series to determine the tuning voltage to be applied to line **125T** for low band tuning and the other divider branch includes resistors R7 to R13 to determine the tuning voltage to be applied to line **125T** for high band operation. Each of the resistors has its tap arm here identified as T2 to T13 respectively connected to a spring-like contact or wiper leaf designated W2 to W13 respectively. The wiper leaves W2 to W6 are shown associated with a common latch bar **27** and wiper leaves W7 to W13 are shown associated with a second common latch bar **28**, with both latch bars being connected in common to the tuning voltage line **125T**.

Thus, when any single wiper leaf is actuated to establish contact with its corresponding latch bar the latch bar applies a voltage determined by the location of the wiper leaf in its branch of the voltage divider network. These voltages are predetermined in accordance with the required levels for tuning the VHF tuner section **22**.



The selector switch mechanism includes an apertured face panel **29** overlying a switch subassembly **30** (FIGURE 5) which includes a base plate **31** that is anchored to bracket portions **32** (FIGURE 2) provided on the rear of the face panel **29**. A mounting clearance **33** exists between the base plate **31** and the face plate **29** as best shown in FIGURE 5 to accommodate the adjustable resistors R2 to R13 at each channel position and the pushbutton actuators P1 to P13 at each channel position. As is best shown for the pushbutton P13 in FIGURE 5, each of the channel pushbuttons has a knurled cap or head portion **34** that projects through the face panel **29** and a shank portion **35** to project through the corresponding resistor R13 and abut the corresponding wiper leaf W13. The shank **35** is in rotary keyed engagement with the collar **36** that is provided with a splined opening, such collar **36** also carrying the rotary tap arm of the adjustable resistor. Thus, rotation of each pushbutton independently effects fine tuning of each channel by varying the rotary position of the corresponding tap arm. Each button is normally held in its projected position as shown for pushbutton P12 at the left side of FIGURE 5 and for the on-off button P at the right side of FIGURE 5.

The base plate **31** is of any suitable insulation material and is provided with upper and lower bar-shaped bearing blocks **37** and **38**, respectively, (see FIGURES 2 and 4) presenting aligned bores for reception of end-pivot stubs **27U**, **27L** on latch bar **27** and end-pivot stubs **28U**, **28L** on latch bar **28**. Each of the lower pivot stubs **27L**, **28L** is provided with a drive gear **39** (FIGURES 2 and 4), with the gears directly inter-engaging so that the latch bars **27**, **28** rotate in unison between a normal spread position wherein they are outwardly flared as shown in view A of FIGURE 6 and a relatively closed position as shown in view C of FIGURE 6. Actually the latch bars **27**, **28** are capable of moving to a substantially fully closed position in that the latch bars are not restrained by any positive stops, but in operation there is no mechanism that forces the latch bars through a swinging arc of such magnitude. Each of the latch bars has a torsion spring **27S**, **28S** in coiled relation over its upper end stub, each torsion spring having one end biased against the corresponding latch bar and the other end biased against the base plate **31** and normally urging the latch bar towards the position illustrated in FIGURES 4, 5 and views A and D of FIGURE 6. Stops **31S** as shown in FIGURE 5 are provided on the plate **31** to engage one or both of the latch bars **27**, **28** and determine the rest position.

As mentioned previously the latch bars **27**, **28** are interconnected to serve as a common tuning voltage bus. As shown the upper bearing **37** rod is provided with leaf-type contacts **27C**, **28C** that are axially biased against the upper ends of the latch bars to establish electrical contact therewith while accommodating required rotation of the latch bars. An insulated conductor wire **40** is bridged between the contacts **27C**, **28C** to complete the common tuning bus connections.

A separate insulated mounting strip **41**, **42** is provided along each of the vertically extending marginal edge regions of the base plate **31**. The left hand mounting strip **41** as viewed in FIGURE 2 receives the fixed ends of the wiper leaves W7 to W13 for channel positions **7** through **13** and the right hand mounting strip **42** receives the fixed ends of the wiper leaves W1–W6 for channel positions **1** to **6**. Each wiper leaf is shown fixed in place by means of a screw and nut fastener **43** so that each leaf has one end free to flex or deflect in the fashion of a cantilever. As is best seen in FIGURES 4, 5 and 6 each wiper leaf has its free end **44** extending into partially overlapping relation with the rounded lobe cam portion **45** of the corresponding latch bar so that upon actuation by the corresponding pushbutton the free end of each wiper leaf

swings through an arc A which intercepts the profile of the rounded-lobe cam portion of the latch bar.

Normally each wiper leaf, other than the actuated one, is in a relatively relaxed position adjacent to the base plate **31** where it holds the associated pushbutton projected. The free end **44** of the selected wiper leaf, in swinging along the travel arc towards raised position, cams against the profile face **45** of the corresponding latch bar to produce joint inward swinging movement of both latch bars as represented in views B and C of FIGURE 6. At the changeover position of view C, the rising wiper leaf clears the inwardly swinging profile face **45** and the latch bars return to normal position. The end portion **44** of the selected wiper leaf, upon release of its pushbutton, finally seats on the top edge of the profile face for the corresponding latch bar. In normal operation, whenever it is desired to select a new channel, the previously actuated wiper leaf which has remained in raised position as shown at the left in view A of FIGURE 6 will initially oppose the joint inward swinging movement of the latch bars but after limited inward swinging movement of the latch bars, as shown in view B the returning wiper leaf assists the inward swing of the latch bars. As shown in view C of FIGURE 6, the rising and the returning leaf springs tend to clear the profile face at approximately the same point so that the released wiper leaf returns to normal position before the actuated wiper leaf reaches its maximum deflection.

In the illustrated arrangement, the switch T of FIGURE 5 is shown mounted in piggy-back relation alongside the channel 1 wiper leaf W–1 to enable actuation of the channel 1 pushbutton P1 to operate the switch T to the upper contact T–1 shown in FIGURE 3 for selecting the UHF tuner section **21**. The wiper leaf W–1 has a lateral extension **46** engageable with the switch T to hold the switch in this position so long as the wiper leaf W1 is seated on top of its latch bar. The switch B for control of high band switching is shown in FIGURE 2 mounted between wiper leaves W–9 and W–10 and it is controlled by a common crank **47** that has offset stub ends **47E** mounted in suitable bearing blocks **48, 49** provided on the rear face of the base plate. The crank **47** has stop rings or washers **50** of hard rubber or other suitable insulation material spaced therealong for mechanical engagement with each corresponding wiper leaf on the high band channel positions. The actuation of any high band channel pushbutton causes the rising wiper leaf to elevate the crank arm **47** as shown in FIGURE 5 in a fashion to swing the band switch B to the Hi position illustrated in FIGURE 3 and to hold this position until the high band wiper leaf is released for return to its normal position. A leaf spring **51** rides against the crank arm **47** to yieldingly bias the same towards its normal position.

Another latch bar construction is shown in FIGURES 7 and 8 wherein a typical latch bar includes a formed sheet metal stamping **52** having a circularly curved main body section **53** that includes integrally extending rolled gripper fingers **54** along a common lengthwise edge thereof to define aligned holders for a through shaft **55** that is pivotally mounted in the bearing blocks **37, 38**. The profile of the cam face **45** curves about the point C. In a typical embodiment the sheet metal stamping is 0.010 inch thick, the radius of curvature of face **45** is 0.125 inch and the diameter of the throughshaft **55** is 0.093 inch. A stop **31S** is shown for cam face **45**.

In FIGURE 8 the latch bar is shown associated with a metallic wiper leaf of the type appearing in FIGURES 1 to 6 for which electrical contact exists whenever camming interaction occurs between a wiper leaf and a latch bar. In some instances where it is desirable to limit electrical contact between the wiper leaf and the latch bar arrangements such as are shown in FIGURES 9 and 10 are utilized.

In FIGURE 9 a metallic wiper leaf **57** is shown provided with an edge strip **58** of an insulating material such as a semi-flexible lubric plastic which prevents electrical contact except when the wiper leaf is raised to seat upon the upper edge of the latch bar **53**. In FIGURE 10, a metal strip **59** and a spacer layer of fish paper or other suitable insulating material are shown disposed on the profile face **45** of the latch bar to prevent electrical contact between the latch bar and wiper leaf **57** except when the wiper leaf is raised to seat upon the upper edge of the latch bar.

It should be understood that the basic mechanical arrangement and action incorporated in the particular selector switch and tuner circuitry shown and described herein, is equally useful with other tuner circuit arrangements. For example, a UHF control circuit may be tuned from one or more selector switch positions in a fully integrated selector switch. The invention thus has wide application with numerous circuit arrangements both for TV tuners and for other tuners as well as for completely different switching controls.

Thus while preferred constructional features of the invention are embodied in the structure illustrated herein, it is to be understood that changes and variations may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

**1.** In a selector switch, a wiper leaf having a resiliently swingable contact portion, an actuator for deflecting the wiper leaf to swing said contact portion through a predetermined arc of travel, a latch bar having a rounded lobe cam portion facing in opposed relation to said arc of travel, and mounting means for determining the path of movement of the latch bar and including resilient means that urges the latch bar to a normal position wherein the profile of said cam portion converges toward and intersects said arc of travel whereby momentary displacement of said cam portion is accommodated during movement of said leaf between a relatively relaxed open position spaced from said contact lobe portion and a relatively stressed closed position upon an edge of said cam portion.

**2.** In a selector switch in accordance with claim **1** wherein said mounting means includes means for mounting said latch bar to rotate about a fixed axis that is generally normal to the plane of said arc of travel and wherein said resilient means biases said latch bar in a rotary direction about said axis.

**3.** In a selector switch in accordance with claim **1** wherein a plurality of wiper leaves are disposed in spaced-apart relation along said latch bar each to engage a corresponding lengthwise region of the cam portion of the latch bar.

**4.** In a selector switch in accordance with claim **3** wherein said mounting means includes means for mounting said latch bar to rotate about a fixed axis that is generally normal to the plane of said travel arc and wherein said resilient means biases said latch bar in a rotary direction about said axis.

**5.** In a selector switch in accordance with claim **3** and including a voltage divider network having, for each wiper leaf position, an adjustable resistor including a rotary tap disposed with a central key opening thereof facing the corresponding leaf in the general direction of swinging movement thereof, said actuator being a pushbutton element having a shank projecting in axially shiftable rotatably keyed relation through said key opening to move axially and engage said wiper leaf intermediately for deflecting the same and to rotate said tap relative to the corresponding resistor.

**6.** In a selector switch in accordance with claim **1** and including a voltage divider network having an adjustable resistor therein and including a rotary tap disposed with a central key opening thereof facing said leaf in the general direction of swinging movement thereof, said actuator being a pushbutton element having a shank pro-

jecting in axially shiftable rotatably keyed relation through said key opening to move axially and engage said wiper leaf intermediately for deflecting the same and to rotate said tap relative to the corresponding resistor.

7. In a selector switch in accordance with claim 1 wherein a second latch bar is disposed in spaced-apart parallel relation alongside the first-named latch bar and has a rounded lobe cam portion facing oppositely from the cam portion of the first-named latch bar, said mounting means includes means interconnecting said latch bars for joint movement of the cam portions, a separate set of wiper leaves disposed in spaced-apart relation along each of said latch bars to engage corresponding lengthwise regions of the cam portions of the latch bars.

8. In a selector switch, a pair of latch bars each having a rounded lobe cam portion, means mounting said latch bars to pivot about parallel axes extending in a side-by-side spaced-apart arrangement wherein said rounded lobe cam portions face in opposite directions, gear means interconnects said latch bars for joint rotation in opposite directions and resilient means rotatably biases said latch bars toward a normal position, a separate set of wiper leaves for each latch bar and disposed in spaced-apart relation therealong, each wiper leaf having a resiliently swingable contact portion to cooperate with the corresponding contact lobe portion, a separate actuator for deflecting each wiper leaf to swing the contact portion thereof through a predetermined travel arc that intersects the profile of the corresponding cam portion and momentarily swings the latch bars from normal position.



9. In a selector switch, a plurality of wiper leaves each having a resiliently swingably deflectable contact portion movable through a predetermined arc, a plurality of actuators, one for each leaf, for swingably deflecting each leaf, a latch bar having a rounded lobe cam portion, and mounting means for the wiper bar inclding resilient means normally urging the latch bar to a location wherein the profile of said cam portion intersects said arc whereby momentary displacement of said cam portion is accommodated during movement of said leaf between a substantially relaxed open position spaced from said cam portion and a relatively stressed closed position.

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U.S. Cl. X.R.

84—1.01; 338—118; 200—153, 18