United States Patent [19]
Fulton

[11] **3,793,521**
[45] **Feb. 19, 1974**

[54] **LIGHT MODULATED VOLTAGE DIVIDER CONTROL**

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[73] Assignee: **Stancomp, Inc.,** Elk Groove Village, Ill.

[22] Filed: **Nov. 13, 1972**

[21] Appl. No.: **305,816**

[52] **U.S. Cl.** **250/199,** 325/465, 334/15
[51] **Int. Cl.** **H04b 9/00**
[58] **Field of Search** 250/199, 217; 325/452, 459, 325/464, 465; 334/8, 15

[56] **References Cited**

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Primary Examiner—Albert J. Mayer
Attorney, Agent, or Firm—J. Patrick Cagney

[57] **ABSTRACT**

A light modulated voltage divider control for tuning voltage responsive television tuners utilizes a separate polarized light filter means corresponding to each channel to be tuned. The polarity orientation of the separate filtering means are individually adjustable. All channel UHF, VHF and VHF-UHF combinations are provided.

26 Claims, 20 Drawing Figures

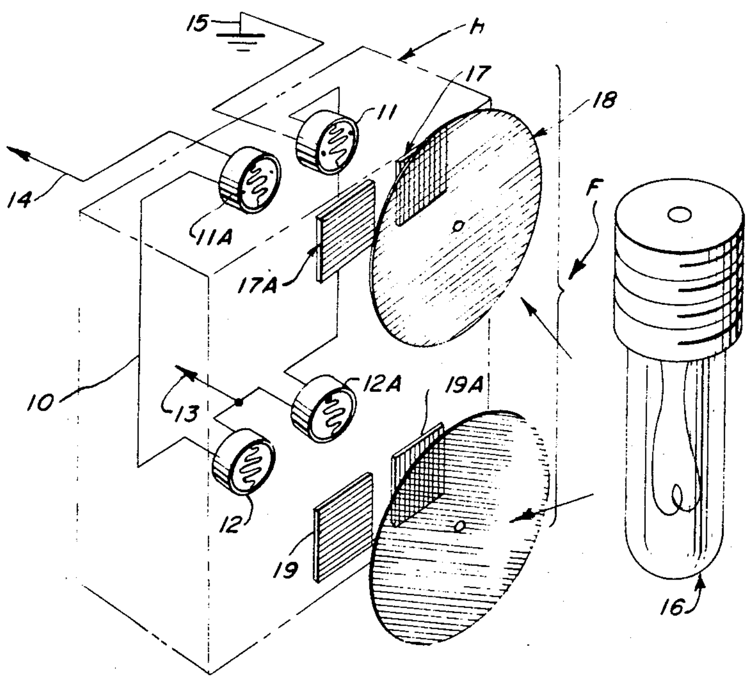


FIG. 1

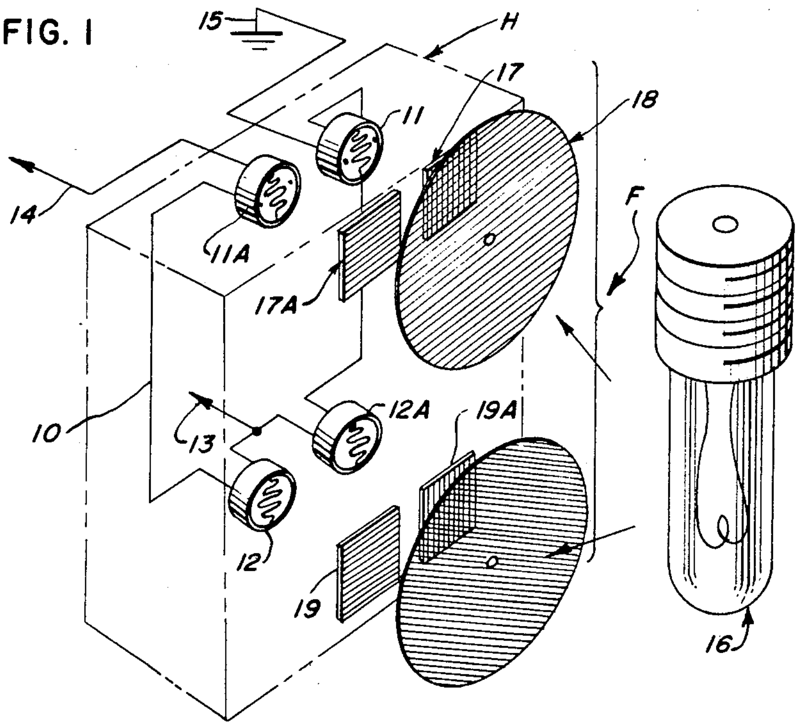
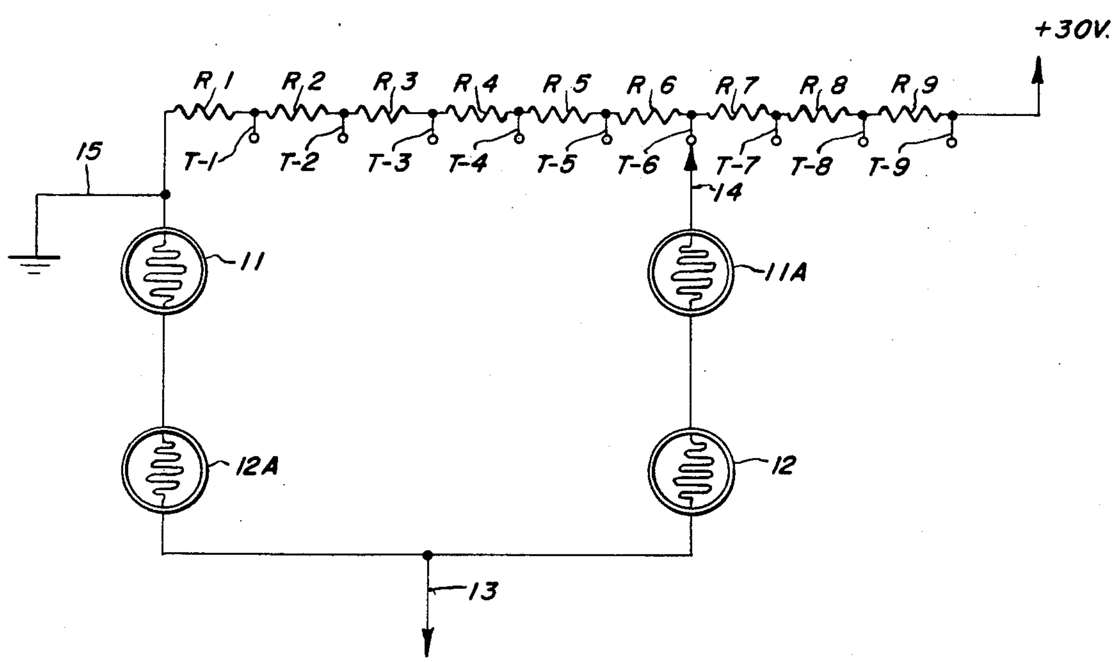

15
H
17
18
11
14
11A
F
17A
10
13
12A
19A
12
19
16

FIG. 2


+30V.
R 1
R 2
R 3
R 4
R 5
R 6
R 7
R 8
R 9
15
T-1
T-2
T-3
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T-5
T-6
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T-8
T-9
14
11
11A
12A
12
13

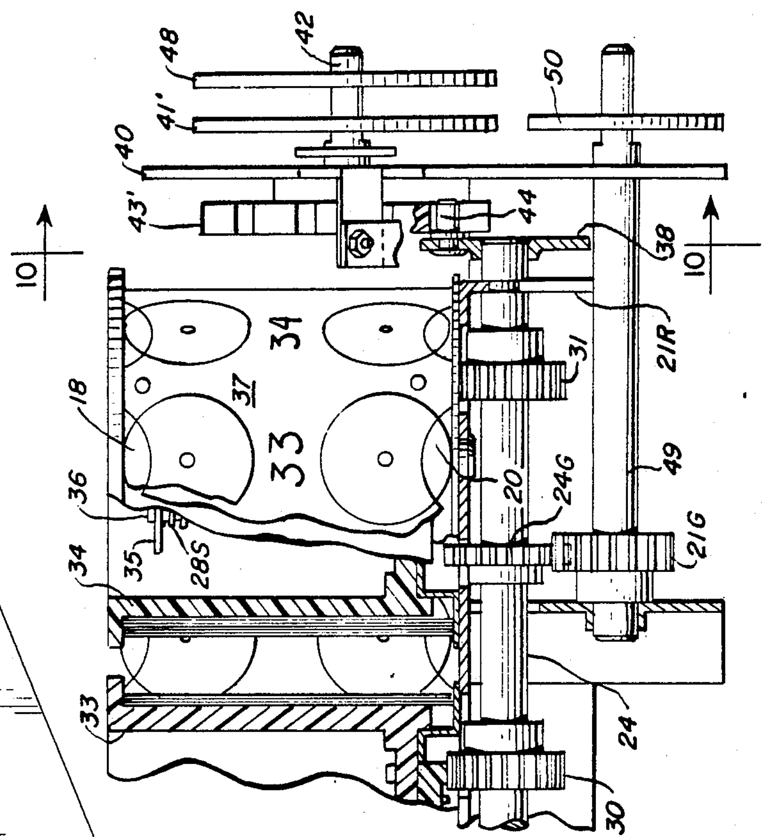


FIG. 9

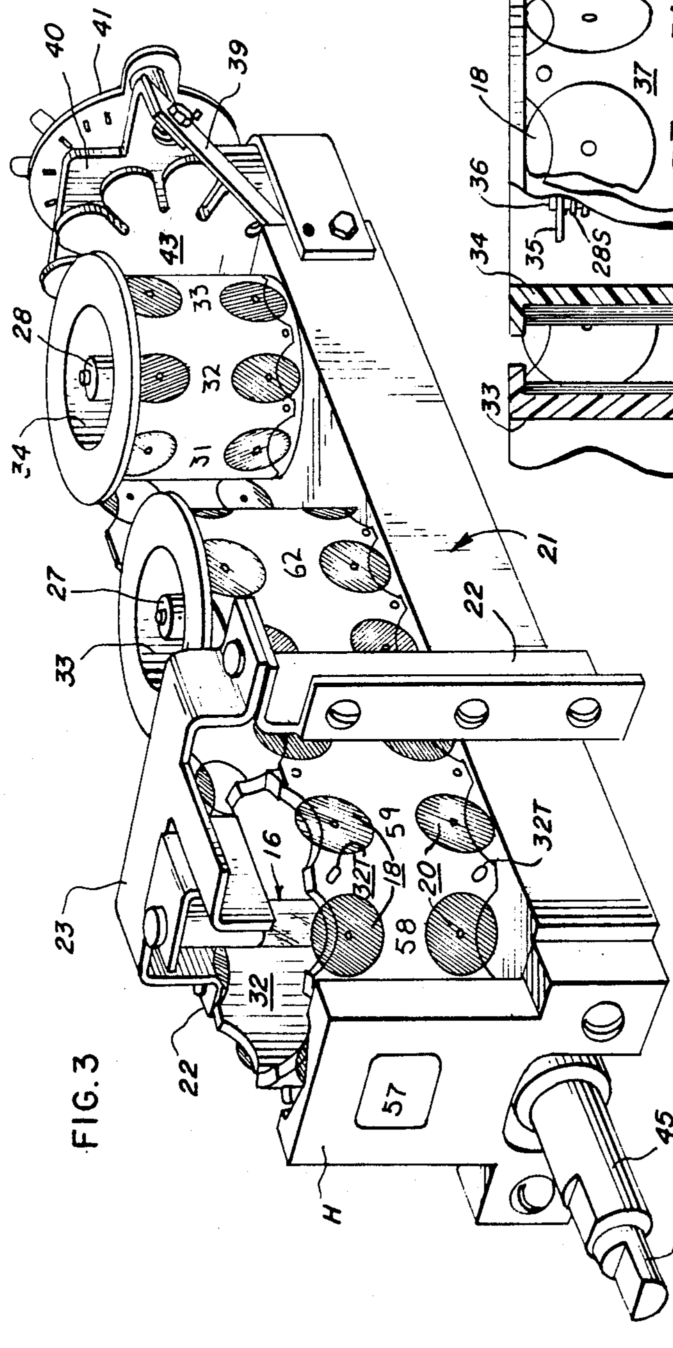


FIG. 3

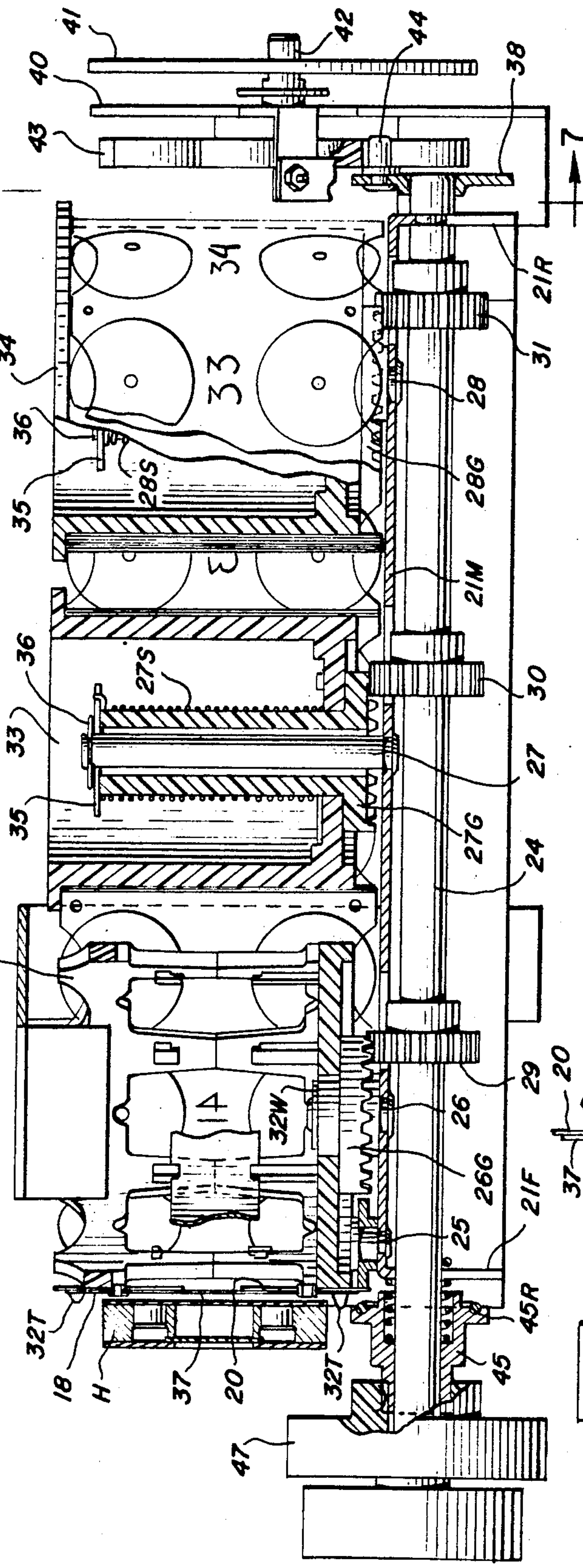


FIG. 4

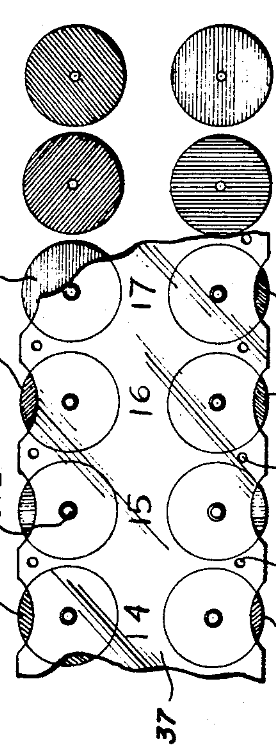


FIG. 6

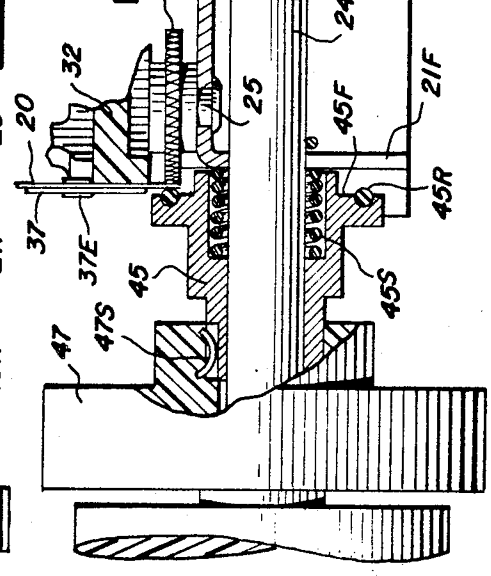


FIG. 5

FIG. 7

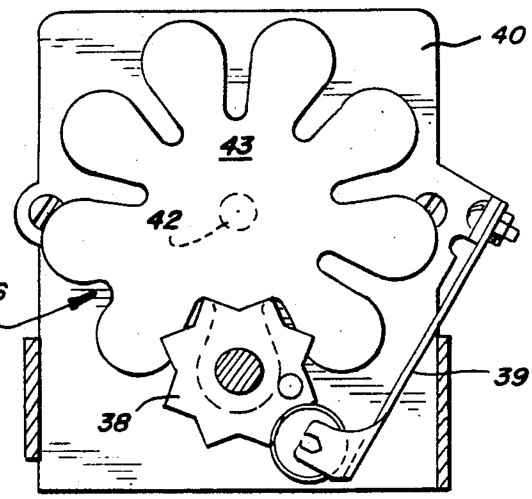


FIG. 10

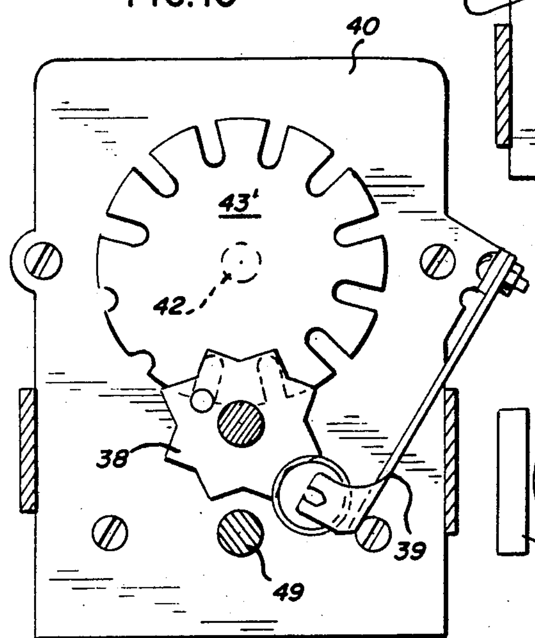
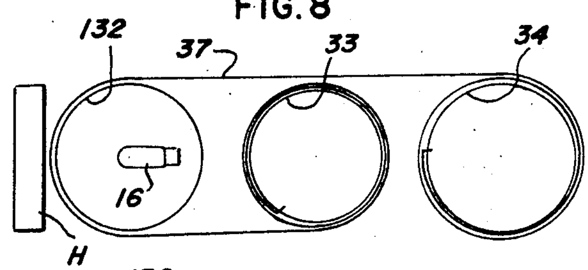


FIG. 8



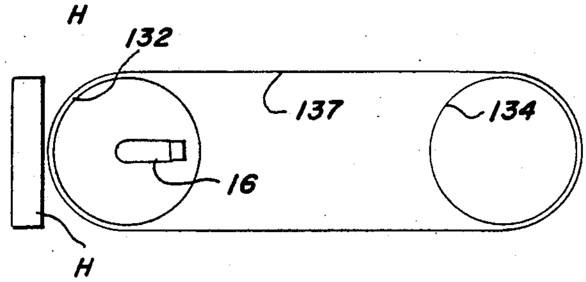
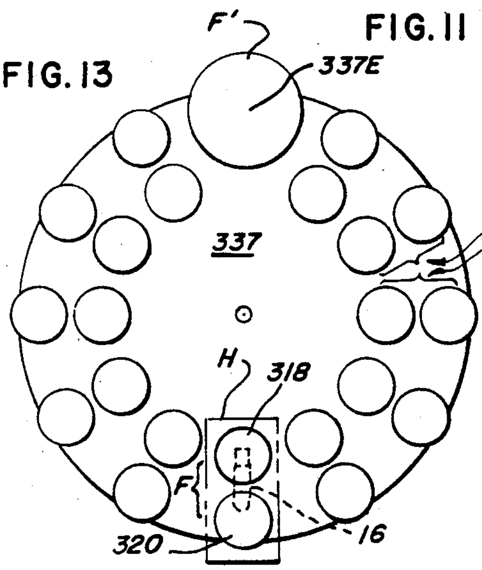


FIG. 11

FIG. 13



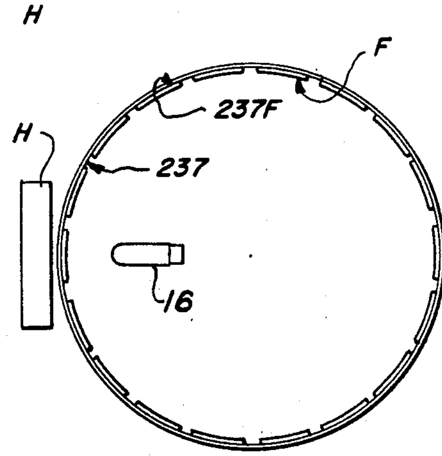


FIG. 12

FIG. 18

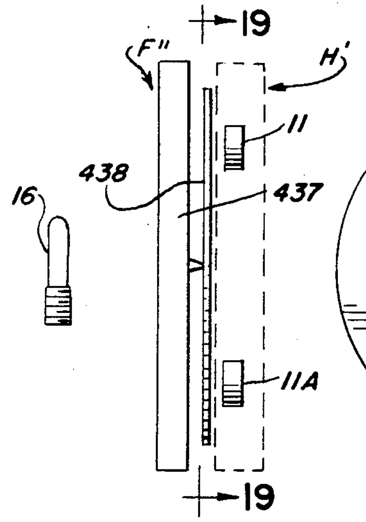


FIG. 19

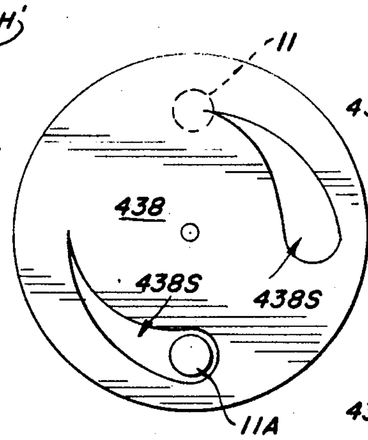


FIG. 20

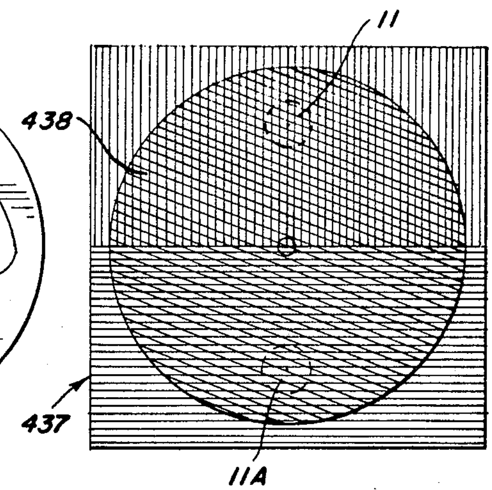


FIG. 14

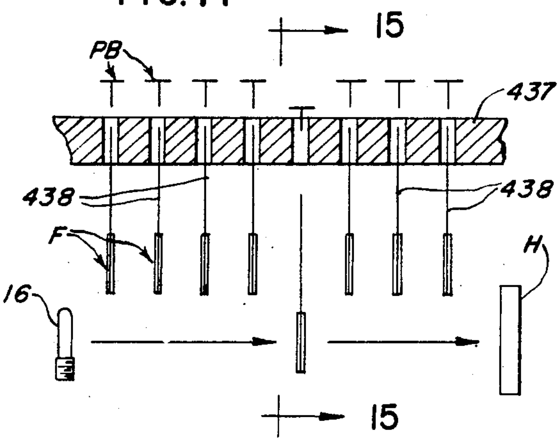


FIG. 15

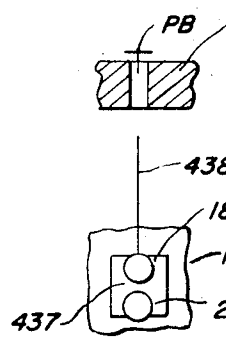


FIG. 16

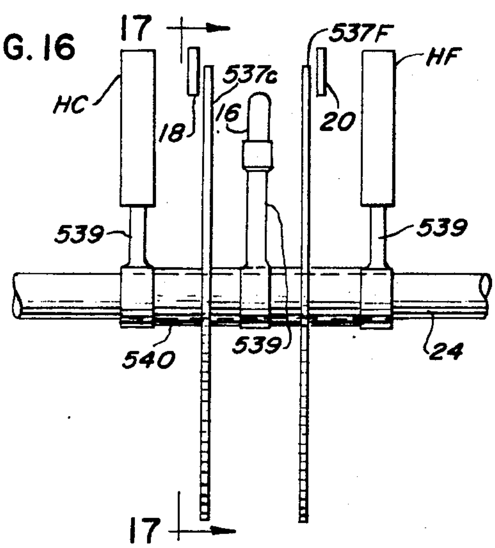
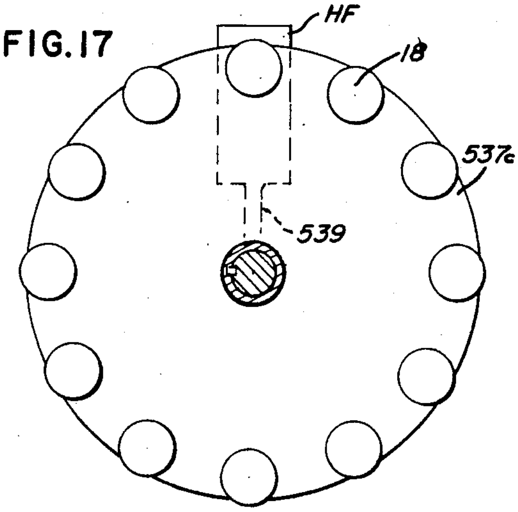


FIG. 17



LIGHT MODULATED VOLTAGE DIVIDER CONTROL

BACKGROUND OF THE INVENTION

Multi-channel tuning controls are required for voltage tuned circuits such as are employed in solid state tuners for the VHF or UHF television bands. Such television tuners incorporate wide band signal selecting resonant circuitry having voltage responsive diode capacitors selectively tunable to any one of a plurality of distinct channels, in accordance with the amplitude level of the tuning voltage applied thereto.

Accordingly, there is a need for a tuning voltage control capable of providing a distinctive predetermined amplitude level corresponding to each channel that is to be tuned. Multi-channel controls of this type are required for VHF television tuners, for UHF television tuners and VHF-UHF tuner combinations.

There is a particular need for multi-channel tuning controls which include separate tuning elements corresponding to each channel so that the channel is selectable by activating the corresponding tuning element.

In addition, in the U. S. there is a requirement that equivalent tuning capability be provided for all television channels. It is desirable that a single tuning control be capable of satisfying these needs for the VHF television band and for the UHF television band in order to provide a complete combination operable from a single control.

SUMMARY OF THE INVENTION

In accordance with this invention a tuning voltage control is provided wherein a voltage divider circuit has photosensitive impedance means exposed to predetermined amounts of light to control the level of the output voltage that is to be applied to a voltage responsive tunable circuit for selecting any one of a plurality of distinct channels. Separate light filtering means corresponding to each channel to be selected are provided and selector means are provided to regulate the amount of light incident on the photosensitive impedance means by directing the same through the particular light filtering means corresponding to the channel to be selected.

In the preferred embodiments, a polarized light voltage divider circuit arrangement is controlled by a plurality of separate polarized light filter means, each having a particular polarity orientation to provide channel selection. In the presently preferred practice of the invention, the polarized light filter means for each channel includes a pair of polarized light filter elements, each acting to modulate the light incident upon a different photosensitive impedance incorporated in the voltage divider circuit so that one filter element determines the coarse selection of a channel and the companion filter element determines the fine tuning.

Embodiments for all channel UHF, all channel VHF and for multi-channel tuners are shown. In these illustrated embodiments, the polarized light filter means are mounted on a common carrier arrangement and the selector moves the carrier to position the corresponding filter means in light intercepting relation at a common station.

Mechanism is provided for indexing the movement of the common carrier to establish desired registry at the

common station and to synchronize the filter selection with other parts of the tuner control system.

An adjustable mechanism is provided to rotate the polarized filter that is at the common station, thereby providing a preset fine tuning capability.

Additional embodiments are illustrated wherein the separate filters are stationary and the light system is movable.

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, and in which like numerals are employed to designate like parts throughout the same:

FIG. **1** is an exploded perspective view illustrating a polarized light voltage-divider control for setting the tuning voltage.

FIG. **2** is a diagram of the tuning voltage circuit for all channel tuners.

FIG. **3** is a perspective view illustrating a complete structural assembly of a tuning voltage control for an all channel UHF tuner.

FIG. **4** is a lengthwise sectional view through the UHF tuner chassis of FIG. **3.**

FIG. **5** is a fragmentary enlarged section of a preset fine tuning control mechanism.

FIG. **6** is a fragmentary face view of a carrier strip that holds separate sets of polarized light filter elements for effecting coarse and fine tuning.

FIG. **7** is a transverse section taken on the line **7—7** of FIG. **4** and showing a detented selector shaft driving a geneva wheel for controlling tap changing of the source voltage applied to the tuning voltage circuit.

FIG. **8** is a diagrammatic plan view illustrating the carrier strip positioning arrangement for the all channel UHF embodiment.

FIG. **9** is a fragmentary lengthwise section showing additional switching structures utilized for an all channel VHF-UHF combination tuner.

FIG. **10** is a transverse section taken on the line **10—10** of FIG. **9.**

FIG. **11** is a diagrammatic plan view illustrating a carrier strip positioning arrangement for an all channel VHF embodiment or for any multi-channel type embodiment.

FIG. **12** is a diagrammatic plan view illustrating a turret type carrier arrangement for applications similar to those of the FIG. **11** embodiment.

FIG. **13** is a face view illustrating a carrier disc embodiment for applications similar to those of the FIG. **11** embodiment.

FIG. **14** is a diagrammatic view of a push button embodiment wherein a plurality of separate filters are selectively positioned in a stationary polarized light system.

FIG. **15** is a transverse view taken on the line **15—15** of FIG. **14.**

FIG. **16** is a side elevational view of a stationary filter embodiment wherein a movable polarized light system is selectively positioned to effect channel selection.

FIG. 17 is a transverse view taken on the line 17—17 of FIG. 16.

FIG. 18 is a diagrammatic view of an alternative type of light filtering system.

FIG. 19 is a transverse view taken on the line 19—19 of FIG. 18 and illustrating a light filtering system utilizing tear drop shaped apertures.

FIG. 20 is a view similar to FIG. 19 but illustrating a light filtering system utilizing moire' patterns.

LIGHT CONTROLLED VOLTAGE DIVIDER SYSTEM

Referring now to the drawings and particularly to FIG. 1, there is shown a voltage divider circuit 10 including series connected impedances 11,12 and an intermediate tap 13 from which output voltage is taken for application to voltage responsive tunable circuits such as are used in VHF and/or UHF television tuners that incorporate voltage dependent variable capacitance diodes. A predetermined value of DC voltage is applied across the voltage divider circuit between the terminal 14 and the grounded terminal 15 to provide DC output voltage at the tap at a level determined by the values of the series connected impedances. Different output voltage levels are provided at the tap 13, each being effective to get the associated tuner to a distinct frequency channel.

To provide channel selection, the impedance relationships in the voltage divider circuit are adjusted by use of photosensitive impedances controlled by varying the amount of incident light acting thereon. Separate light filtering means for each channel to be tuned are provided, each such filtering means being collectively designated at F. Selector means control the amount of incident light to set the tuner to any desired frequency channel by directing the incident light through the filtering means that corresponds to the desired channel.

As shown in FIG. 1, the voltage divider circuit 10 is mounted at a common station to be exposed to light from a light source 16 and the separate filtering means F are selectively positioned in incident light modulating relationship at the common station.

For application with voltage controlled television tuners, the light controlled voltage divider system shown in FIG. 1 utilizes a polarized light system and provides for both coarse channel selection and fine tuning channel selection. Accordingly, each of the impedances 11,12 is a photosensitive impedance such as a cadmium sulfide cell, the impedance cells 11 and 12 being mounted in spaced relation in a control head H disposed in separate incident light paths.

To provide polarized light control of the voltage divider circuit, the light path to the cell 11 is directed through a fixed position polarized filter 17 mounted in the head H and through a polarized filter element 18 that has a predetermined polarity orientation in accordance with the frequency channel represented thereby. Rotary adjustment of the polarized filter element 18 produces wide range voltage changes at the output voltage tap 13 to enable coarse selection of any channel within the tuning range determined by the applied voltage at the tap 14 relative to the particular parameters of the tunable circuit.

Correspondingly, the light path to the cell 12 is directed through a fixed position polarized filter 19 in the head H and through a polarized filter element 20 that is rotatable to effect fine tuning of the channel selected by filter element 18. The polarized filter elements 18,20 collectively constitute the filtering means F that determines a particular frequency channel.

To compensate for ambient changes such as temperature or light intensity, the cell 11 has a matching cell 11A located adjacent to it in the head and has a fixed polarized filter 17A associated with it. Correspondingly, the cell 12 has a matching cell 12A that receives light through a polarized filter 19A.

The cells 11,11A receive only polarized light directed through polarized filter element 18 and the cells 12,12A receive only polarized light directed through polarized filter element 20.

The polarizing filters or lenses 17,17A are orthogonally related so that rotation of the disc-shaped element 18 causes an increase in polarized light to one cell and a decrease in polarized light to the matched cell. The net effect is to produce a change in resistance of the cells 11,11A that is coarsely controlled in accordance with the rotary position of the filter element 18 of the selected filtering means F.

Correspondingly, the polarizing filters 19 and 19A are orthogonally related and produce a change in resistance of the cells 12,12A that is finely controlled in accordance with the rotary position of the filter element 20 of the selected filtering means F.

Since the cells of each matched pair are located in close proximity and are mounted in the common head H, ambient temperature changes have an equal effect on all four cells and cause a uniform rise or drop in resistance, thus maintaining a uniform ratio of resistance and, hence, a uniform output voltage at the tap 13 for any given channel selection setting.

In a typical UHF tuner circuit the impedance of the coarse tuning cell 11 may range from 5K to 85K ohms and the impedance of the fine tuning cell 12 may range from 0.3K to 5k ohms.

ALL CHANNEL EMBODIMENT

For the particular embodiment disclosed in FIGS. 2 to 8, a tuning voltage control is provided to tune to each of the 70 channels of the UHF television band. As shown in FIG. 2, the voltage divider circuit 10 is arranged for selective connection to any one of a series of tap points provided along a series chain of resistors for the purpose of setting the level of applied voltage at the tap 14 in accordance with the particular range of UHF channels to be selected. Fixed resistors R-1 through R-9 are connected in series to present tap points T-1 through T-9 for connection to the terminal 14 to determine the voltage to be applied across the voltage divider circuit. This applied voltage at terminal 12 is divided as previously described in accordance with the amount of polarized light acting on the photosensitive impedance means.

For the particular embodiment shown herein, tap T-1 is connected to terminal 14 when any one of UHF channels 1–21 are to be tuned; T-2 is connected for any one of channels 22–29; T-3 is connected for any one of channels 30–37; T-4 is connected for any one of channels 38–45; T-5 is connected for any one of channels 46–53; T-6 is connected for any one of channels 54–61; T-7 is connected for any one of channels 62–69; T-8 is connected for any one of channels 70–77; and T-9 is connected for any one of channels 78–83.

As previously stated each channel which is to be tuned is controlled by a separate light filtering means

F, such filtering means being set in relation to the level of the applied voltage at terminal **14** to allow the correct amount of light to be directed upon the voltage dividing photosensitive impedances.

SPECIFIC DESCRIPTION OF UHF EMBODIMENT

In the all channel UHF embodiment illustrated herein for purposes of disclosure, the polarized light voltage divider system of FIGS. **1** and **2** is incorporated in a main chassis **21** equipped with a pair of outboard mounting brackets **22** that are connected by a bridge-like brace **23** that supports the electrical socket for the bulb **16** that serves as a light source. The chassis **21** is of a hollow inverted box-shaped configuration and is provided with aligned apertures in its front and rear end walls **21F**,**21R** to support a tuning selector shaft **24** that extends completely through and beyond both ends of the chassis.

The main support wall **21M** of the chassis is provided with a set of vertical studs consisting of a fine tuning stud **25**, a sprocket mounting stud **26**, and front and rear spool mounting studs **27,28**. A drive gear **29** is mounted intermediately on the tuning shaft **24** to project through the main wall of the chassis and mesh with a spindle gear **26G** journalled on the sprocket mounting stud **26**; similarly a drive gear **30** is mounted on the tuning shaft **24** to mesh with a spindle gear **27G** journalled on the forward spool mounting stud **27** and drive gear **31** is mounted towards the rear of the tuning shaft to mesh with a spindle gear **28G** journalled on the rear spool mounting stud **28**.

A hollow, generally cylindrical drive sprocket **32** is mounted to move with the sprocket gear **26G** and separate front and rear film take-up spools **33,34** are mounted to move with the remaining spindle gears **27G,28G**. Each of the take-up spool arrangements is shown to include a helical bias spring **27S,28S**, each bias spring being anchored by means of a spring retainer washer **35** and a snap ring **36**. The drive sprocket **32** is anchored by a snap ring **32W** and is provided with two sets of circularly spaced teeth **32T** to mesh with drive holes in a carrier strip **37**.

As best seen in FIG. **5**, a common carrier for the separate filtering means F that are provided for each of UHF channels **14** to **83** is in the form of an elongated strip **37** of a suitable clear material that does not polarize light, for example, acetate-butyrate or vinyl. The strip **37** is shown with feed holes **37H** to receive the sprocket teeth **32T**. Channel identification numbers are imprinted along the lengthwise center line of the strip and the pair of coarse and fine tuning polarized elements **18,20** that define each filtering means are rotatably mounted above and below the channel numbers to modulate the amount of light incident upon the photosensitive cells **11,12** in accordance with the polarity orientation of the disc-shaped elements **18,20**. The edges of the strip **37** have successive recesses and each of the filtering elements are attached to the strip by eyelets **37E** so that the periphery of the disc elements intercepts the recesses, thus providing convenient access for rotary adjustment of the discs.

As shown in FIGS. **3** and **8**, one end of the strip **37** is coiled about the front take-up spool **33**, and the other end of the strip is coiled about the rear take-up spool **34**, with the intermediate region of the strip being trained about the sprocket **32** which controls movement of the strip and registry of the selected filtering means at the control station.

The strip drive sprocket **32** turns in **1—1** ratio with the main tuning shaft **24** and is arranged to present eight strip portions in registered relation to the head H of the polarized light system at the common control station during one full revolution of shaft **24**. In the case of the illustrated embodiment each such strip frame portion is 0.750 inches long, so that 52.5 inches of usable strip length are required to move past the front center line of the polarizing system to tune to each of the **70** channels of the UHF band. When each of the separate filtering means F on the strip is at the control station, the channel number corresponding to such filtering means is in registry with a central window in the head H so that the light source which controls the tuning voltage selection also back lights the channel number.

The selector shaft **24** acting through drive gears **29, 30** and **31** drives the sprocket **32** and spools **33,34** in synchronism, with the bias springs **27S,28S** continuously acting to take up any slack. This arrangement allows any length strip to be mounted within a compact space, without impairing the optical characteristics of the filtering means F and without displacing the predetermined rotary positions of the individual filtering elements carried on the strip.

Accurate registry of the selected filtering means F at the common station is provided by an **8**-position indexing gear **38** affixed to the rearwardly projecting end of the shaft **24** and cooperating with a spring detent arm **39**. The chassis **21** is provided with a rearwardly projecting support bracket **40** that mounts the detent arm **39** and that also mounts facilities for synchronizing the tap changing movement of terminal **14** with the particular groups of UHF channels that correspond to each of the tap points **T-1** to **T-9**.

The tap changing mechanism includes an eight-step, nine position wafer switch **41** having the set of series connected resistors **R-1** to **R-9** mounted thereon to present the nine tap points **T-1** to **T-9**. The contact arm of the wafer switch corresponds to the input terminal **14** of the voltage divider circuit. The wafer switch **41** is mounted on a common shaft **42** with a geneva wheel **43** that is driven by a pin **44** projecting from the eight-position indexing wheel **38** to synchronize the rotation of the detented tuning shaft **24** with the rotation of the wafer switch.

The drive ratio is such that each revolution of the detented tuning shaft **24**, during which the strip **37** is advanced **8** channel positions, indexes the wafer switch one step of its **8**-step rotary movement. The tuning shaft is restricted to **8**-three-fourths revolutions by providing the geneva wheel with a shallow ninth slot **43S** to present the full **70** channel positions on the strip and present positive stops at opposite ends of the strip travel.

To set the filtering means F for tuning each channel, the upper or coarse tuning filtering elements **18** are rotatably oriented to bring in the corresponding channel and once set will remain in proper adjustment, unaffected by strip movement.

A fine tuning mechanism for adjusting the lower or fine tuning element filter **20** of each set, as shown in FIG. **5**, includes a stepped diameter sleeve-like fine tuning shaft **45** mounted in telescoping relation on the projecting front end of the main selector shaft **24** and normally biased outwardly by a helical spring **45S** which reacts between the front wall **21F** of the chassis and a recessed spring seat portion of the fine tuning shaft. The fine tuning shaft **45** has an annular rear face **45F** provided with a circular recess that mounts a rubber O-ring **45R**, the upper peripheral sweep of which is aligned with a knurled washer **46** that is journalled on the fine tuning stud **25.** Axial pressure applied to a fine tuning knob **47** keyed on the fine tuning shaft by a pressure spring **47S** causes the peripherally projecting portion of the fine tuning filter element that is at the tuning station to be engaged between the knurled washer **46** and the O-ring **45R** for rotating the same until its polarity orientation is such as to produce the desired impedance for effecting selection of the optimum tuning voltage. Once adjusted the element retains its selected rotary position.

ALL CHANNEL VHF-UHF COMBINATION

An embodiment that provides separate filter means F corresponding to each of the 12 VHF channels and to each of the 70 UHF channels is basically similar to the UHF embodiment of FIGS. **3** to **8** but is modified at the rear of the chassis as shown in FIGS. **9** and **10** to include additional switching functions.

Thus, the geneva wheel **43′** is a 12-position wheel and is driven by pin **44** on an 8-position detent disc **38** so that one revolution of the selector shaft **24** produces 1/12 revolution of the geneva wheel **43′**. The shaft **42** for the geneva wheel **43′** carries a 12-position wafer switch **41′**. An additional **12**-position wafer switch **48** is provided on the rear of the shaft **42** to provide for certain switching functions required in the all channel VHF-UHF embodiment. In addition, a stub shaft **49** is journalled within the rear of the chassis **21** and is driven through gears **21G,24G** to rotate in **1—1** ratio with the selector shaft **24.** An eight-position wafer switch **50** is carried on the rear of the stub shaft **49** and has its contacts wired to the additional VHF positions provided on the wafer switch **41′**.

It should be noted that in the described arrangement of FIGS. **9** and **10,** the 12-position geneva wheel **43′** provides the same 8 UHF positions as previously described and also provides one position for the low band VHF channels 2 – 6 and one position for the high band UHF channels 7–13. The two remaining positions serve as stops to define the end points of the travel range.

To provide the same UHF functions, the wafer switch **41′** is provided with an identical set of resistors **R-1** to **R-9** and its terminals serve as an identical set of tap points **T-1** to **T-9.** The 8-position wafer switch **50** has selected contacts connected to two VHF terminals on the wafer switch **41′** and other contacts connected to various tap points of the resistor chain to allow the level of the voltage applied to the voltage divider circuit to be switched to various levels for the VHF mode.

Thus, while wafer switch **41′** is positioned at its low-band VHF terminal, the wafer switch **50** is stepped through successive positions for each of channels **2** to **6** to vary the level of the applied voltage. Correspondingly, while wafer switch **41′** is positioned at its high-band VHF terminal, the wafer switch **50** is stepped through successive positions for each of channels **7** to **13.**

This arrangement is presently preferred because the switching of the applied voltage levels allows the light intensity variations required for tuning to each successive channel to be reduced. It should be noted that the typical voltage range required to tune a UHF variable capacitance diode tuner across the entire UHF band is from about 2.4 volts to about 21.8 volts. By comparison, the typical range required for the low-VHF band (channels **2–6**) is from about 1.5 volts to about 16.6 volts and the typical range required for the high-VHF band (channels 7–13) is from about 7.1 volts to about 20.7 volts.

Thus, the desired tuning voltage between adjacent VHF channels changes much more abruptly than the tuning voltage changes between adjacent UHF channels. The settings of the separate filter means F can provide the abrupt changes in tuning voltage in the VHF bands by providing correspondingly abrupt changes in light intensity but under such conditions the history of light effect (hysteresis) would cause the response of the photosensitive impedances to be somewhat slow.

The described switching arrangement provides changes in the applied voltage in the VHF band so that the changes in light intensity from channel to channel are limited sufficiently to allow for rapid response of the photosensitive impedances. The particular details of resistor values and switch connections for accomplishing the above is subject to numerous choices, any of which can be used in the practice of this invention by those skilled in the television tuner art.

The additional wafer switch **48** serves to provide a number of functions, as follows:

For a VHF tuner using variable capacitance diodes in conjunction with switching diodes, the tuner is switched from low-band mode to high-band mode by reversing the polarity of the control voltage applied to the switching diodes. One face of the switch **48** is connected to effect switching of this control voltage as the selector shaft **24** moves from the channel **6** to the channel **7** position.

In addition, the same face of the switch **48** is wired to effect switching of B+ voltage from the VHF tuner to the UHF tuner as the selector shaft **24** moves from the channel **13** to the channel **14** position.

The other face of the switch **48** is provided with contacts to switch the TV receiver's AGC signal from the VHF tuner to the UHF tuner between the channel **13** and **14** positions.

Where AFC switching (similar to AGC switching) is required for the particular TV receiver, an additional wafer switch is provided on the shaft **42.**

ADDITIONAL EMBODIMENTS

FIG. **11** illustrates an arrangement utilizing a carrier strip **137** in the form of a continuous loop trained about a front drive sprocket **132** and a rear guide spool **134.** In this form the strip may be provided with separate filtering means F corresponding to each of the VHF channels. Alternatively the strip **137** may be provided with a group of filtering means F (for example, six) adjustable to selected VHF channels and with a second group of filtering means F (for example, six) adjustable to selected UHF channels. Any combination of VHF and UHF channels can be provided on the strip **137** in accordance with the requirements for the tuner.

FIG. **12** illustrates an arrangement wherein a multimount turret **237** functions as a carrier, wherein each arcuate face **237F** of the turret is provided with a separate filtering means F. The number of face regions and, hence, the number of separate channels may be varied substantially as described above.

FIG. **13** illustrates an arrangement wherein a flat faced disc **337** serves as a common carrier to support any desired number of peripherally spaced filtering means F. Where the disc **337** is translucent, the light path may be directed through the material of the disc **337**. The filtering means F may comprise a pair of polarized elements shown at **318,320** as being in registry with the head H at the common tuning station. Alternatively, the filtering means may consist of a single adjustable filtering disc F' which as shown at the top of the disc **337** is mounted on an eyelet located adjacent the disc periphery to present a substantial exposed region of filter media. Such an arrangement is illustrated to show the application of the invention with a disc **337** of opaque material, in which case the light path is outside of the disc periphery. While the embodiments of FIGS. **11** to **13** are only shown schematically, it should be noted that in actual practice provisions would also be made for detenting to insure accurate channel selection and for fine tuning as necessary.

Other embodiments of multi-channel tuning voltage controls are shown in FIGS. **14** and **15** and in FIGS. **16** and **17** to illustrate other applications utilizing separate filtering means for each channel in combination with a polarized light voltage divider system.

In the embodiment of FIGS. **14** and **15**, each filtering means F is controlled by a separate push-button PB to be movable from a retracted position to a light-intercepting position between a light source **16** and a sensing head H. The location of the filtering means along the light pah does not affect the system operation. Each filtering means F is of the type shown in FIG. **15** wherein the coarse tuning filter **18** and fine tuning filter **20** are rotatably mounted on a clear support **437** which is carried at the end of a push button arm **438** that is shiftably positioned in a common mounting frame **437F**. As is well known, the push buttons PB are self-latching and gang-connected normally to remain depressed until another push button is actuated.

In the embodiment of FIGS. **16** and **17** an annular array of coarse tuning filters **18** are individually rotatable on a common stationary mounting disc **537C** and a matching array of fine tuning filters **20** are individually rotatable on a corresponding common stationary mounting disc **537F**. Each tuning filter **18** and corresponding tuning filter **20** constitute a composite filtering means that are simultaneously exposed to light from a common source **16.**

A sense head Hc is equipped with the coarse tuning photosensitive impedances **11,11A** and with appropriate fixed filters **17,17A** (see FIG. **1**). Similarly, a sense head Hf is equipped with the fine tuning photosensitive impedances **12,12A** and with appropriate fixed filters **19,19A** (see FIG. **1**).

The sense heads Hc and Hf and the light source **16** are carried by aligned radial arms **539** that are gang-connected to a main shaft **24** by means of a sleeve **540.** The shaft **24** is rotatable to associate the light system with any matched pair of filters **18,20** to select each channel tuning voltage. Direct wiring of the electrical elements can be employed where shaft **24** is limited to one revolution by means of positive stops.

Continuous rotation of shaft **24** can be accommodated by providing commutators on the shaft **24** for effecting the electrical connection to the sense heads Hc and Hf and to bulb **16.**

While polarized light systems are presently preferred from the standpoint of cost, production control and uniformity of performance, other light filtering systems are shown in FIGS. **18, 19** and **20** wherein different filtering means regulate the amount of light incident upon the photosensitive impedances. The general system arrangement is shown in FIG. **18** as including a light source **16** transmitting light along separate paths to photocells **11,11A** in a control head H'. A filtering means F'' corresponding to one channel to be tuned is shown interposed in the light paths, it being understood that separate filtering means F'' are provided for each channel to be selected in accordance with any of the embodiments previously described but not including that of FIG. **14.**

As shown in FIG. **19,** the filtering means F'' may utilize an opaque disc **438** rotatably mounted on a translucent carrier **437** to be positioned immediately adjacent the cells **11,11A.** The disc **438** is provided with teardrop shaped slits **438S** matched to the locations of the photocells **11,11A** in a relationship wherein rotation of the disc **438** causes opposite changes in the amount of light incident upon the photocells **11,11A.** No fixed filters are required for the head H' in this embodiment.

As shown in FIG. **20,** the filtering means F'' may utilize a translucent disc **438** having a moire' pattern and rotatably mounted on a translucent carrier **437** having complementary moire' patterns in a relationship wherein rotation of the disc **438** causes opposite changes in the amount of light incident upon the photocells. Alternatively, the complementary moire' patterns may be provided as fixed filters in the head H' and the carrier **437** may be clear.

The light modulating controls described herein for regulating a voltage divider circuit that controls voltage responsive television tuners can be used for controlling the electrical characteristics of other photosensitive elements. For example, a light sensitive transistor can be controlled to oscillate at various frequencies by controlling the light intensity incident thereon. Similarly, a light sensitive diode could be controlled by means of the light modulating controls disclosed herein.

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.

What is claimed is:

1. A tuning voltage control for setting the voltage level to be applied to voltage responsive tunable circuit means for selectively tuning the same to any one of a plurality of distinct frequency channels, said control comprising a voltage divider cicuit including series connected impedances and an intermediate tap connected thereto, at least one of said impedances being a photosensitive impedance, and means for applying a unidirectional voltage across said circuit to provide output voltage at said tap determined by the value of each of said impedances, means for directing polarized light on said photosensitive impedance, and selector means for controlling the amount of polarized light incident upon said photosensitive impedance to thereby set the output voltage at said tap to different amplitude levels each of which corresponds to a different one of said channels, said selector means including a plurality of separate polarized light filter means each corresponding to a different one of said channels to be tuned, mounting means holding each of said filter means in a particular polarity orientation in accordance with the corresponding one of said channels to be tuned by such filter means and actuating means corresponding with said mounting means for directing the light incident upon said photosensitive impedance through any one of said polarized light filter means.

2. A tuning voltage control as defined in claim 1 and wherein said mounting means includes means for holding said filter means in shiftable relation to accommodate polarity orientation adjustment thereof.

3. A tuning voltage control as defined in claim 1 wherein said mounting means includes means for holding said filter means in shiftable relation to accommodate polarity orientation adjustment thereof, said selector means including means for adjusting the polarity orientation of the selected filter means when it is in light intercepting relation.

4. A tuning voltage control as defined in claim 1 and wherein said mounting means comprises a common carrier mounting said separate filter means in spaced relation thereon and said actuating means shifts said common carrier to effect selective positioning of any one of said filter means in light intercepting relation at a common station.

5. A tuning voltage control as defined in claim 4 and wherein said selector means includes means for adjusting the polarity orientation of the selected filter means when at said common station.

6. A tuning voltage control as defined in claim 4 wherein said filter means are in predetermined spaced relation along said common carrier and wherein said actuating means includes indexing means to control shifting of said common carrier to automatically register successive ones of said filter means at said common station.

7. A tuning voltage control as defined in claim 4 wherein said common carrier comprises an elongated strip having said separate filter means mounted in lengthwise spaced relation therealong.

8. A tuning voltage control as defined in claim 4 wherein said common carrier comprises an elongated strip of translucent material having said separate filter means mounted in lengthwise spaced relation therealong, each of said separate filter means comprising a disc rotatably mounted in overlapping relation upon said strip to maintain its polarity orientation during movement of said strip.

9. A tuning voltage control as defined in claim 1 and wherein said means for applying voltage includes a chain of resistors connected across a source of voltage and presenting a set of tap points at different predetermined voltage levels and a shiftable contact sequentially engageable with said tap points and connected to apply voltage across said voltage divider circuit, said mounting means including a common carrier holding separate filter means in predetermined spaced relation to define sets of said filter means in one-to-one correspondence with said tap points.

10. A tuning voltage control for setting the voltage level to be applied to voltage responsive tunable circuit means to selectively tune the same to any one of a plurality of distinct frequency channels, said control including a voltage divider circuit including series connected impedances and an intermediate tap connected thereto, at least one of said impedances being a photosensitive impedance, and means for applying a voltage across said divider circuit to provide an output voltage at said tap determined by the value of each of said impedances, a source of light incident upon said photosensitive impedance, and selector means for controlling the amount of light incident upon said photosensitive impedance to thereby set the output voltage at said tap to different levels each of which corresponds to a different one of said channels, said selector means including a plurality of separate light filter means each having a particular light transmitting characteristic corresponding to a different one of said channels to be tuned, mounting means holding each of said filter means, and actuating means cooperating with said mounting means for directing the light incident upon said photosensitive impedance through any one of said filter means.

11. A tuning voltage control as defined in claim 10 wherein the light incident on said photosensitive impedance means is polarized light and wherein said filter means are of polarized light filter media and wherein said mounting means includes means for holding said filter means in shiftable relation to accommodate polarity orientation adjustment thereof.

12. A tuning voltage control as defined in claim 11 and wherein said mounting means comprises a common carrier mounting said separate filter means in spaced relation thereon and said actuating means shifts said common carrier to effect selective positioning of any one of said filter means in light intercepting relation at a common station.

13. A tuning voltage control as defined in claim 10 and wherein said mounting means comprises a common carrier mounting said separate filter means in spaced relation thereon and said actuating means shifts said common carrier to effect selective positioning of any one of said filter means in light intercepting relation at a common station.

14. A tuning voltage control as defined in claim 13 wherein said filter means are in predetermined spaced relation along said common carrier and wherein said actuating means includes indexing means to control shifting of said common carrier to automatically register successive ones of said filter means at said common station.

15. A tuning voltage control as defined in claim 13 wherein said common carrier comprises an elongated strip having said separate filter means mounted in lengthwise spaced relation therealong.

16. A tuning voltage control as defined in claim 13 wherein said common carrier comprises an elongated strip of translucent material having said separate filter means mounted in lengthwise spaced relation therealong, each of said separate filter means comprising a disc rotatably mounted in overlapping relation upon said strip to maintain its rotary orientation during movement of said strip.

17. A tuning voltage control as defined in claim 10 and wherein said mounting means mounts said separate filter means in side-by-side retracted position and said actuating means selectively shifts any one of said filter means into light intercepting relation.

18. A tuning voltage control as defined in claim 10 wherein said mounting means mounts said separate filter means in predetermined stationary position and said

actuating means shifts the incident light path to direct the light through any one of said separate filter means.

19. A tuning voltage control for setting the voltage level to be applied to voltage responsive tunable circuit means for selectively tuning the same to any one of a plurality of distinct channels, said control comprising a voltage divider circuit including first and second photosensitive impedances and an intermediate tap between said impedances, means for applying a unidirectional voltage across said circuit to provide output voltage at said tap determined by the value of each of said impedances, means for directing polarized light along separate paths towards each of said impedances, and selector means for controlling the amount of polarized light incident upon each of said impedances to thereby set the output voltage at said tap to different amplitude levels each of which corresponds to a different one of said channels, said selector means including a plurality of separate polarized light filter means each corresponding to a different one of said channels, each of said separate filter means including first and second polarized light filter elements, mounting means holding the filter elements of each of said separate filter means in a particular polarity orientation in accordance with the corresponding one of said channels to be tuned by such filter means and actuating means cooperating with said mounting means for directing the light incident upon said photosensitive impedances through any one of said filter means to modulate the amount of polarized light incident upon said first and second impedances in accordance with the polarity orientation of the first and second filter elements of the selected filter means.

20. A tuning voltage control as defined in claim **19** and wherein said mounting means comprises a common carrier mounting said separate filter means in spaced relation thereon and said actuating means shifts said common carrier to effect selective positioning of any one of said filter means in light intercepting relation at a common station.

21. A tuning voltage control as defined in claim **20** and wherein said selector means includes means for adjusting the polarity orientation of one of the filter elements of the selected filter means when at said common station.

22. A tuning voltage control as defined in claim **20** wherein said filter means are in predetermined spaced relation along said common carrier and wherein said actuating means includes indexing means to control shifting of said common carrier to automatically register successive ones of said filter means at said common station.

23. A tuning voltage control as defined in claim **20** wherein said common carrier comprises an elongated strip of translucent material having said separate filter means mounted in lengthwise spaced relation therealong, each filter element of each of said separate filter means comprising a disc rotatably mounted in overlapping relation upon said strip to maintain its polarity orientation during movement of said strip.

24. A tuning voltage control as defined in claim **19** and wherein said mounting means mounts said separate filter means in side-by-side retracted position and said actuating means selectively shifts any one of said filter means into light intercepting relation.

25. A tuning voltage control as defined in claim **10** wherein said mounting means mounts said separate filter means in predetermined stationary position and said actuating means shifts the incident light path to direct the light through any one of said separate filter means.

26. A light modulating control for regulating a photosensitive element that controls a tunable circuit means for selectively tuning the same to any one of a plurality of distinct frequency channels, said control comprising means for directing polarized light on said photosensitive element, and selector means for controlling the amount of polarized light incident upon said photosensitive element to thereby vary the electrical characteristics of said element to different values each of which corresponds to a different one of said channels, said selector means including a plurality of separate polarized light filter means each corresponding to a different one of said channels to be tuned, mounting means holding each of said filter means in a particular polarity orientation in accordance with the corresponding one of said channels to be tuned by such filter means and actuating means corresponding with said mounting means for directing the light incident upon said photosensitive element through any one of said polarized light filter means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,793,521 Dated February 19, 1974

Inventor(s) William L. Fulton

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 4, line 58: "1-21" should be --14-21--;

Col. 9, line 34: "pah" should be --path--.

Signed and sealed this 22nd day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents