# United States Patent [19]

**Sandoval**

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[54] **TRANSMISSION SYSTEM**


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[52] **U.S. Cl.** ..... **340/147 R,** 340/147 LP
[51] **Int. Cl.** ..... **H04q 3/00**
[58] **Field of Search** ..... 340/147 R, 147 LP



[56] **References Cited**

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| | | | |
|---|---|---|---|
| 3,610,960 | 10/1971 | Hofstein | 307/251 |
| 3,774,195 | 11/1973 | Schulthess | 340/324 R |



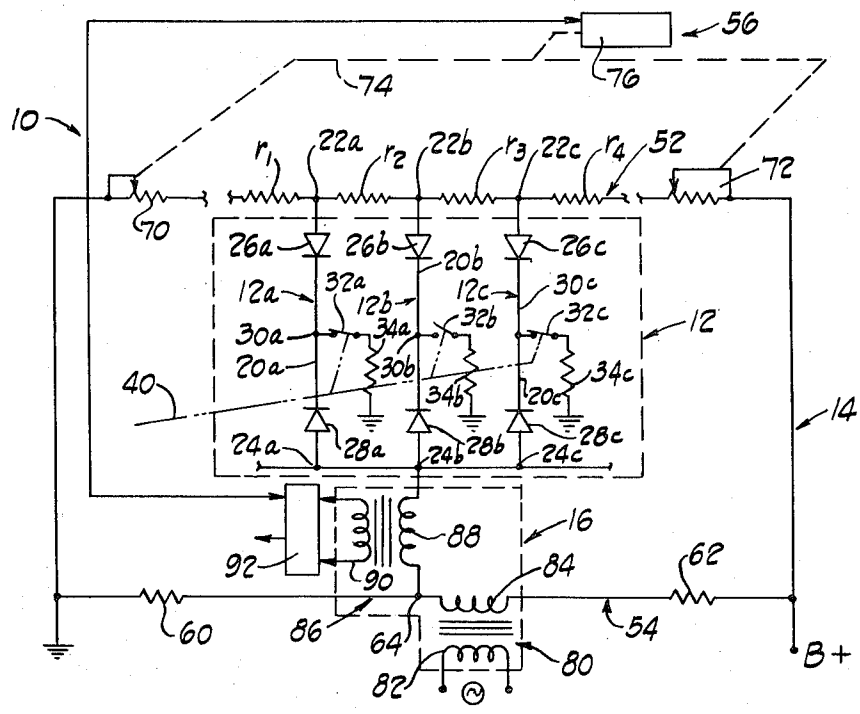
*Primary Examiner*—Harold I. Pitts
*Attorney, Agent, or Firm*—Watts, Hoffmann, Fisher & Heinke, Co.



[57] **ABSTRACT**

The invention contemplates systems for transmitting signals or the like via selected ones of a number of separate paths by establishing a null across a selected path location to enable the path effective to transmit a signal. One disclosed embodiment of the invention is a binary memory storage unit. Another disclosed embodiment is an electrical intercommunication system. Still another disclosed embodiment features an adjustable iris.


**20 Claims, 6 Drawing Figures**



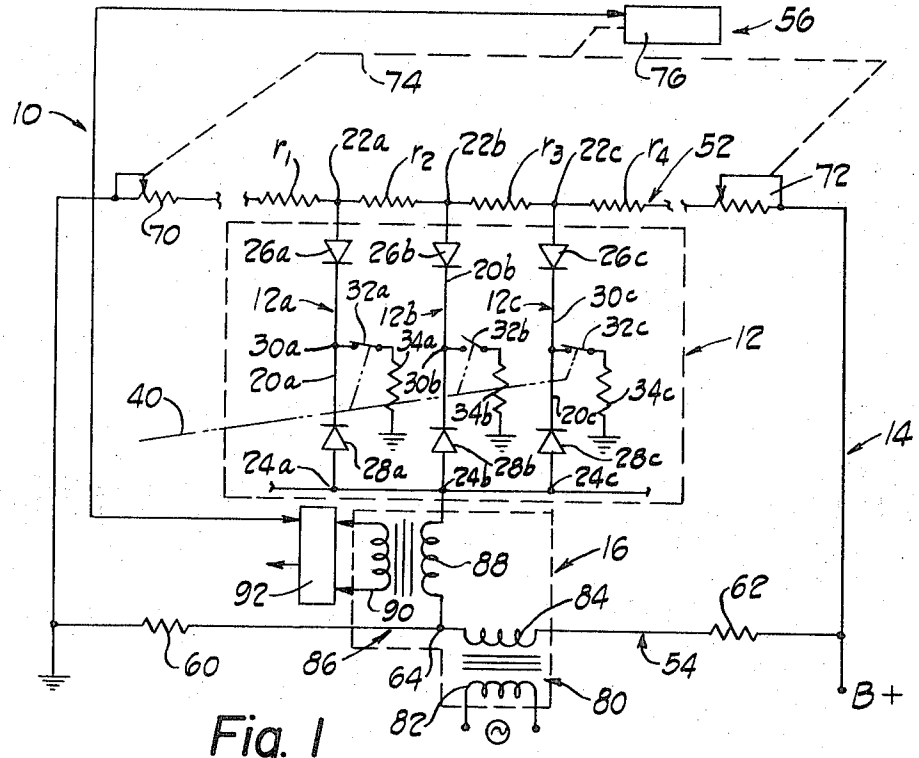

56
74
76
10
r1
22a
r2
22b
r3
22c
r4
52
72
70
26a
26b
20b
26c
12a
32a
12b
12c
30c
30a
34a
32b
32c
12
20a
30b
34c
40
34b
20c
14
24a
28a
24b
28b
24c
28c
16
88
92
90
84
62
60
86
64
54
B+
80
82

Fig. 1

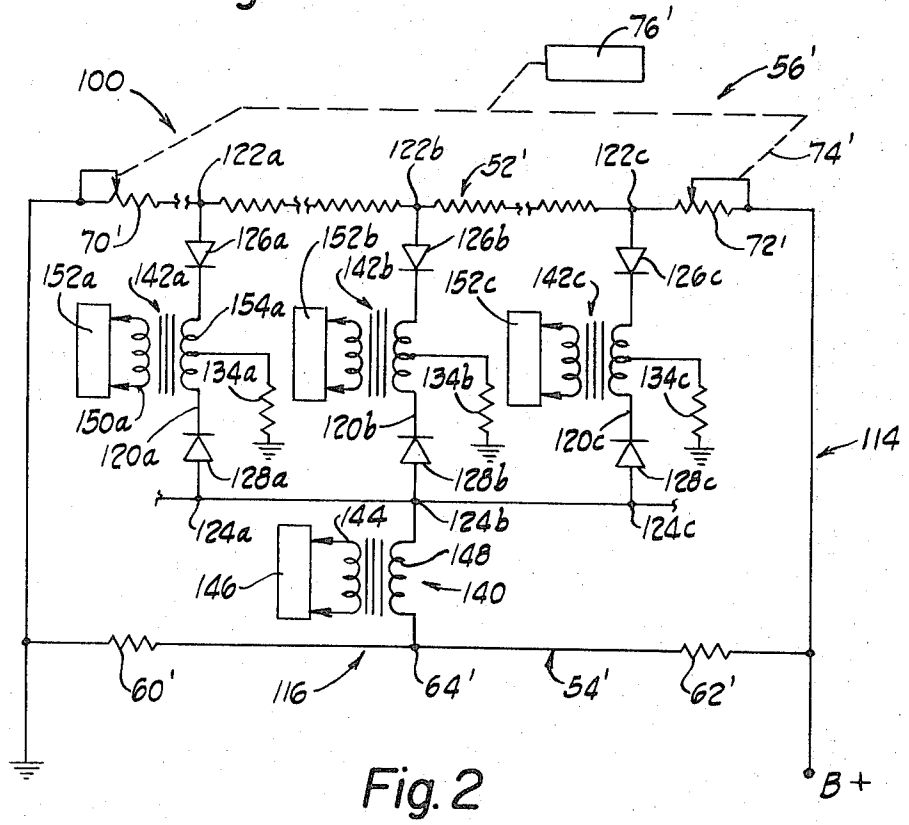

76'
56'
100
122a
122b
52'
122c
74'
70'
72'
126a
152b
126b
152a
142a
142b
152c
142c
126c
154a
134a
134b
134c
150a
120a
120b
120c
114
128a
128b
128c
124a
124b
124c
144
148
146
140
60'
116
64'
54'
62'
B+

Fig. 2

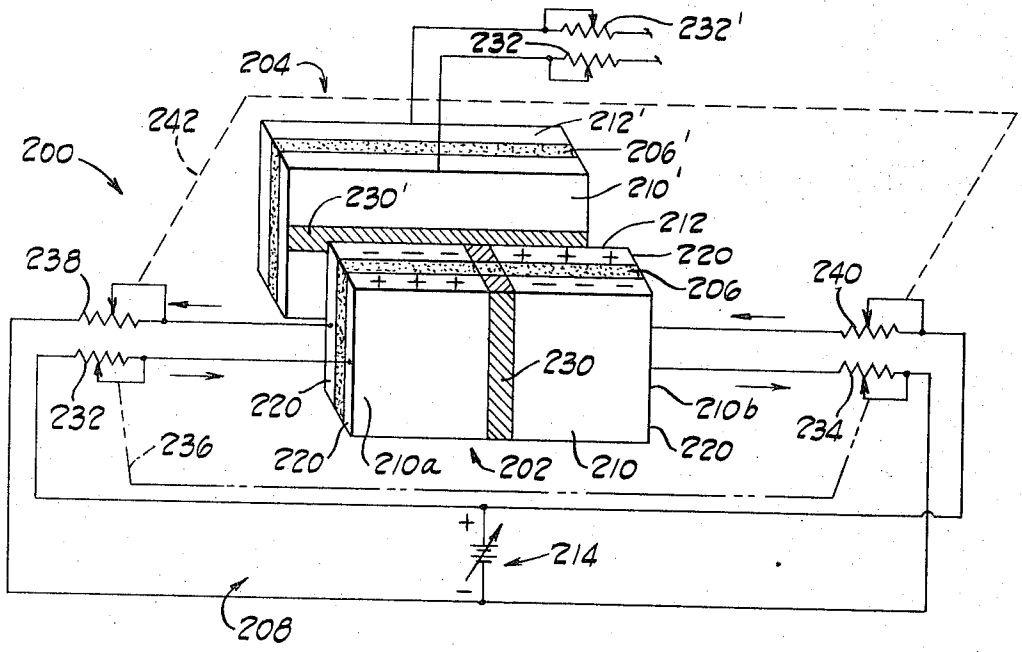



Fig. 3

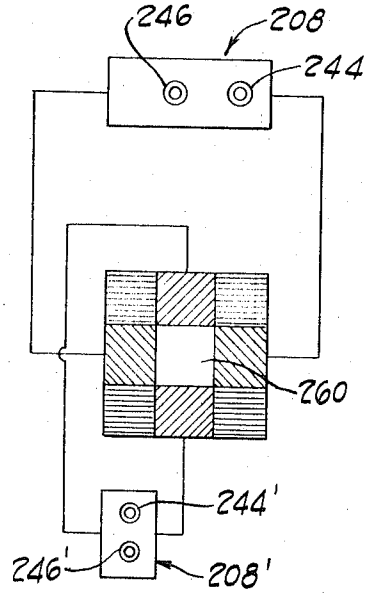



Fig. 4

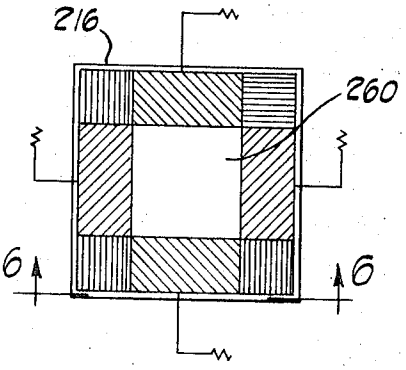



Fig. 5

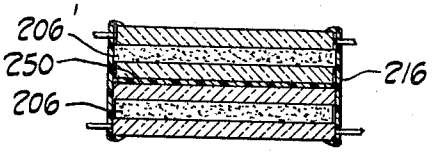



Fig. 6

# TRANSMISSION SYSTEM

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a new and improved system for transmitting information or electromagnetic energy via selected paths of a number of parallel paths.

2. Prior Art

The prior art has proposed various systems and arrangements for transmitting information or power via selected ones of parallel paths but in the main these prior art proposals have been of relatively complicated construction and have exhibited functional disadvantages. Some prior art systems have been formed by electrical networks in which a succession of parallel voltage responsive circuits were connected across a power supply via some form of resistive conductor. The voltage across all of the circuits was increased until an initial circuit was rendered conductive in response to the applied voltage. Conduction of the initial circuit resulted in energization of a load or in transmission of a signal via that circuit. Continued increase of the voltage applied across the parallel circuits resulted in a second parallel circuit being rendered conductive in response to the voltage applied across it. When this occurred, the voltage across the first circuit was increased so that the first circuit tended to remain in a conducting state.

In order to achieve selectivity, the prior art proposed feedback interconnections between the successive parallel circuits so that, for example, when the second circuit in a succession was rendered conductive, the initial circuit was consequently rendered nonconducting even though the applied voltage level was otherwise sufficient to maintain the first circuit conducting. The feedback interconnections have complicated the prior art constructions.

Examples of this kind of electrical circuit are disclosed by U.S. Pat. No. 3,610,960 and U.S. Pat. No. 3,358,157.

The prior art proposals utilized power supply current to operate the load and/or provide a signal transmitted by the selected conducting circuit. This type of operation resulted in fluctuations of the voltage levels applied across the various parallel circuits particularly during transition periods in which two parallel circuits were momentarily conductive. In order to avoid such voltage fluctuations the resistive conductors had to be constructed to assure substantial voltage drops between successive parallel circuits, or the power supply had to be provided with a sensitive regulator.

The principle of operation of the prior art proposals has been such that use of prior art circuitry of the character referred to has been restricted to a relatively few applications, such as an analog to digital converters.

## SUMMARY OF THE INVENTION

The present invention contemplates systems for selectively transmitting information, power or electromagnetic energy via a series of independent parallel paths. The principle of operation of the invention enables a wide variety of usages, and systems embodying the invention can be extremely simple, compact, capable of operation at high speed and utilize small amounts of power.



An important feature of the invention resides in applying voltages across parallel conductors so that when the differential voltage between locations on the conductors is substantially zero, information or power signals or electromagnetic energy can be transmitted between the locations.

The zero differential potential location can be scanned or moved stepwise along the conductors so that transmission of the signals, etc. can occur via selected paths between the conductors. The scanning or stepping of the zero potential locations can be accomplished with great speed and when applied across selected locations, the transmission of signals, etc. does not draw appreciable current from the voltage establishing power supply.

In a preferred construction of the invention, a network defining a plurality of independent paths is connected in parallel across a selection system. The selection system comprises a power supply, parallel conductors connected across the power supply and between which the paths extend, and at least a selector element for varying the voltage level applied across at least one conductor. The paths are selectively rendered effective to transmit signals or information by controlling operation of the selection system.

At least one parallel conductor is resistive along its length so that the applied power supply voltage drops proceeding along that conductor. The parallel paths are connected to the resistive conductor at spaced apart locations so that the voltage applied across each path between the conductors is unique. The selector element is operable to enable the voltage applied across the resistive conductor to shift relative to a reference level and when the selector element is operated, a null, or zero potential differential, is establishable across selected paths.

The parallel paths are constructed so that they compare the voltage levels at their junctures with the conductors and are rendered effective to transmit information or power only when a null, or a substantially zero voltage differential, is established across them. The location of the null is shifted by the selector element so that the null location can be scanned along the parallel paths or can be adjusted to place the null across a given selected path. When a given path is rendered effective, information, power or electromagnetic energy can be transmitted via that comparator path but not via other paths having voltages applied across them.

The transmitted information or power is supplied from a source which is separate from the selection system power supply.

One disclosed embodiment of the invention is a memory unit which includes a selection system associated with parallel memory storage comparator paths. Each of the parallel comparator paths is constructed so that it can be conditioned to transmit a signal or not to transmit a signal when a null is established across that path. Hence each comparator path can store binary information.

The selection system can either scan the null across the comparator paths at a prearranged rate or can be operated to establish the null across a selected path to permit selective access to the stored information. In any event the location of the null is determinable so that the binary information stored by each path is accurately and quickly retrievable.

In another disclosed form of the invention, information can be transmitted between selected remote locations and a master station by providing signal transmitting and receiving devices associated with each of the parallel comparator paths and with the master station. The selection system functions to select one of several comparator paths by shifting the null along the parallel conductors to the desired path.

Another embodiment of the invention provides an electrically controlled iris which is devoid of the usual iris defining mechanical parts which must be adjusted to control the aperture size. In this embodiment of the invention an assembly is provided in which the selection system controls the passage of electro-magnetic energy through parallel comparator paths defined, in effect, by a body of liquid crystal material. The parallel conductors of the selection system are defined by first and second parallel extending electrically resistive sheets of transparent material.

The liquid crystal material is disposed between the conductor sheets. The liquid crystal material in the desired electromagnetic frequency ranges (e.g. the visible light portion of the spectrum), is transparent where the potential across the crystal material between the sheets is nulled, or approximately zero, and is opaque where the applied potential is not approximately zero.

The power supply of the selection system applies a D.C. potential across the ends of the first resistive sheet so that the applied voltage drops proceeding across the sheet. A D.C. potential is likewise applied across the corresponding ends of the second sheet with the polarity of the applied voltage reversed. This creates a band, parallel to the sheet ends and across the liquid crystal material, along which a null exists across the crystal material. The liquid crystal material is transparent along this band allowing the passage of electromagnetic radiation. The selection system, by controlling the voltage magnitudes of the voltages applied across the conductor sheets, can change the width and location of the zero potential transparent band.

A duplicate second assembly is juxtaposed with the first assembly and is oriented so that the transparent band formed by the second assembly extends transverse to the direction of extent of the first band and thus a generally rectangular aperture, formed by the area of intersection of the bands, is provided by the assemblies.

The size of the aperture is controllable by varying the power supply voltage applied across the conductive sheets of the assemblies. When the power supply voltage is minimized, virtually the entire area of the assemblies is transparent to the electromagnetic radiation. As the applied power supply voltage is increased the widths of the transparent bands become progressively narrower and the aperture size is reduced.

An iris constructed according to the principles of the invention also enables the location of the aperture to be shifted to any desired location in the assemblies.

Other features, advantages and uses of the present invention will become apparent from a consideration of the following detailed description made with reference to the accompanying drawings which form a part of this specification.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of a binary memory unit embodying the present invention;

FIG. **2** is a schematic diagram of a system for transmitting information between a master location and a selected one of a number of remote locations according to another preferred embodiment of the invention;

FIG. **3** is a schematic perspective view of an adjustable iris embodying the present invention;

FIGS. **4, 5** and **6** show further constructional features of the iris of FIG. **3.**

## DESCRIPTION OF PREFERRED EMBODIMENTS

A binary memory unit **10** embodying the present invention is illustrated in FIG. **1** of the drawings. The binary memory unit **10** comprises a network **12** of memory storage comparator paths individually indicated at **12***a*–**12***c*. The paths **12***a*–**12***c* are individually selectively rendered effective to provide stored binary memory information by operation of a selection system **14.** Binary information from individual comparator paths, in the form of the presence or the absence of a singal, is obtained by signal circuitry generally indicated at **16.** The selection system functions to selectively establish a null across one of the comparator paths while providing a D.C. voltage across the remaining paths. The signal circuitry provides an A.C. input signal which can be transmitted to a signal output only by a path which is conditioned to transmit and which has a D.C. null established across it. Memory information is produced whenever a null is established across a desired comparator path since the path will transmit the signal if so conditioned and will not transmit the signal if not so conditioned.

## THE COMPARATOR PATHS

While only three comparator paths **12***a*–**12***c* are illustrated it should be appreciated that an extremely large number of these paths can be provided in the system **10** so that the binary information stored by the system can be quite large. The paths **12***a*–**12***c* are each conditionable to transmit signals and when so conditioned each path compares the voltage levels existing at its opposite ends. When the voltage level at the opposite ends of such a comparator path are equal (i.e. when a null or zero potential exists across the path) the path is effective to transmit a signal indicating the character of the binary information stored by the path. If the path is not conditioned to conduct, even though a null is established across it the path will not transmit. This provides binary information by reason of the absence of the signal transmission.

The paths **12***a*–**12***c* are identical and accordingly only the path **12***a* is described in detail. The path **12***a* comprises a conductor **20***a* having opposite end junctions **22***a*, **24***a* by which the conductor **20***a* is connected across the selection system **14.** Oppositely poled diodes **26***a*, **28***a* are connected in the conductor **20**a between the junctions **22***a*, **24***a* with the cathode electrodes of each of the diodes **26***a*, **28***a* connected to a junction **30***a* which is grounded through a path conditioning circuit comprising a switch **32***a* and an impedance element formed by a resistor **34***a*.

When the switch **32***a* of the conditioning circuit is open, the path **12***a* is conditioned so that it cannot transmit A.C. signals even though the D.C. voltage across the junctions **22***a*, **24***a* is nulled. When the switch **32***a* is closed, the path **12**a is conditioned to transmit signals, but only when the D.C. voltage across the junctions **22***a*, **24***a* is nulled. The resistor **34***a* is

large so that conduction to ground via the closed switch **32***a* is minimized. It should be appreciated that the path conditioning circuitry could be provided by a suitable solid state circuit which would provide relatively high impedance when the path is conditioned to conduct and infinite impedance when the path is conditioned not to conduct. Use of such a solid state device would enable the network **12** and associated portions of the selection system **14** to be formed by an integrated circuit thus enabling a great number of memory storing paths to be formed in a relatively small volume package.

The comparator path **12***a* is constructed so that when a differential D.C. voltage is applied across the junctions **22***a*, **24***a*, the comparator path is nonconductive regardless of the position of the switch in the path conditioning circuit. When the voltage level with respect to ground at the junction **22***a* is greater than the voltage level with respect to ground at the junction **24***a*, the diode **26***a* is forward biased while the diode **28***a* is back biased and the path **12***a* is nonconductive to both A.C. and D.C. When the voltage level with respect to ground at the junction **24***a* is greater than the voltage level with respect to ground at the junction **22***a*, the diode **28***a* is forward biased while the diode **26***a* is back biased and the path **12***a* is again nonconductive.

Assuming that the switch **32***a* is closed to condition the path **12***a* for conduction, when the voltage at the junction **24***a* with respect to ground is equal to the voltage level with respect to ground at the junction **22***a*, the diodes **28***a*, **26***a* are both forward biased and conducting through circuits established from the junctions **22***a*, **24***a*, through the respective diodes and to ground via the switch **32***a* and the resistor **34***a*. When the diodes **26***a*, **28***a* are both forwardly biased, the path **12***a* abruptly becomes conductive to applied A.C. power and the path **12***a* is thus capable of transmitting A.C. signals.

The path **12***b* is illustrated as conditioned against conduction since the switch **32***b* is open. When a null is established across the end junctions **22***b*, **24***b* no A.C. signal can pass since the diodes **26***b*, **28***b* are not forwardly biased.

The impedances of the resistors **34***a*–**34***c* determine the amplitude, or strength, of the A.C. signal transmitted by the respective paths **12***a*–**12***c*. If desired, the resistors **34***a*–**34***c* can be potentiometers which provide preselectable impedance levels so that the signals transmitted by the respective paths can have different, predetermined strengths. As the individual impedance values are reduced, the signal strength is increased and vice-versa.

A suitable actuator **40** for the switches **32** is schematically illustrated in FIG. **1.** The switch actuator **40** is constructed so that individual ones of the switches **32***a*–**32***c* can be opened or closed as desired to effectively store binary information. It should be understood that the actuator **40** can be formed by suitable circuitry in the event that the switch **32** and resistor **34** are replaced by solid state devices as noted above.

## THE SELECTION SYSTEM

The selection system **14** functions to selectively apply a null across the individual paths **12***a*–**12***c* to enable retrieval of binary information from the comparator paths. In the preferred embodiment of the invention the selection system **12** comprises a D.C. power supply indicated by the character B+, parallel resistive conductors **52, 54** connected across the power supply to ground, and a selector mechanism **56** for enabling the retrieval of the binary information from selected comparator paths of the network **12.**

The conductor **52** is preferably formed by suitable material which provides for a gradual, substantial power supply voltage drop along its length. The paths **12***a*–**12***c* are connected to the conductor **52** via the junctions **22***a*–**22***c*, respectively. The junctions are connected to the conductor **52** at electrically spaced locations along the conductor so that the voltage level with respect to ground at each junction **22***a*–**22***c*, respectively, is unique (i.e. it is different from the voltage level at the remaining junctions). The construction of the conductor **52** as described provides resistances indicated by the characters **r1**–**r4** between successive comparator path junctions.

The conductor **54** as illustrated is formed by a voltage divider including series connected resistors **60, 62** between which an output voltage junction **64** is located. The conductor **54** could be constructed the same as the conductor **52,** if desired, with the junction **64** formed in the conductor at a location to provide an output voltage proportional to the power supply voltage. The junctions **24***a*–**24***c* of the paths **12***a*–**12***c* respectively are electrically connected in common to the output voltage junction **64** so that the voltage level with respect to ground at the junctions **24***a*–**24***c* are all the same. The power supply voltages across each comparator path are thus each of different magnitude or polarity and only one comparator path can have a null established across it.

The selector mechanism **56** is effective to change the voltage level with respect to ground applied across the conductor **52** from the power supply B+ to thereby change the respective voltages at the junctions **22***a*–**22***c* with respect to the voltage at the output junction **64.** This permits a null to be established across any individual selected comparator path of the network **12.** In the preferred embodiment, the selector mechanism **56** comprises selector potentiometers **70, 72** at opposite ends of the conductor **52.** The wiper of each of the potentiometers **70, 72** is connected by a linkage **74** to an actuator **76.** When the actuator **76** is operated the effective resistances of the potentiometers **70, 72** are changed simultaneously.

The potentiometers **70, 72** are operated to shift the level of the voltage applied across the conductor **52** while maintaining the power supply current substantially constant. This is accomplished by connecting the potentiometers **70, 72** to the linkage **74** so that when the actuator **76** is operated in one direction the resistance of the potentiometer **70** increases while the resistance of the potentiometer **72** decreases correspondingly and vice-versa when the actuator operates in the opposite direction. By way of example, when the resistance of the potentiometer **72** is minimum the resistance of the potentiometer **70** is maximum so that the voltage drop across the potentiometer **72** is very small and the voltage level with respect to ground at the end of the conductor **52** adjacent the potentiometer **72** is substantially at the power supply voltage level. Conversely, when the actuator **76** operates the potentiometers to maximize the voltage drop across the potentiometer **72** while minimizing the drop across the potentiometer **70,** the voltage level with respect to ground at

the end of the conductor **52** adjacent the potentiometer is minimum. In this manner, although the magnitude of the voltage drop across the conductor **52** is constant, the level of the voltage applied across the conductor **52,** with respect to ground, is varied according to the operation of the actuator **76.** The construction of the potentiometers **70, 72** enables the total resistance of the potentiometers and the conductor **52** to remain constant throughout the range of operation of the actuator.

The actuator **76** may be an electric motor operated at a known speed to scan the voltage applied across a conductor **52** so that successive paths of the network **12** are enabled to provide memory information. Alternatively, the actuator can be operated to change the voltage across the conductor **52** stepwise between predetermined levels to access a desired path of the network **12.**

Although the selector mechanism **56** is illustrated as comprised of potentiometers, a linkage and a linkage actuator, the selector mechanism can be constructed by suitable solid-state circuitry capable of performing the same functions. The construction of such equivalent solid-state circuitry will enable the selector mechanism **56** to be formed by the use of integrated circuit techniques to thus minimize the size of the system **10.**

## THE SIGNAL CIRCUITRY

The signal circuitry **16** functions to provide an input signal which is applied across the conductors **52, 54** so that when an individual comparator path of the network **12** has been conditioned to conduct and a null has been established across that path, the path transmits the input signal to an output device. The circuitry **16** comprises an input transformer **80** having a primary winding **82** connected to an A.C. power supply and a secondary winding **84** which is connected in the selection system **14** at a desired location. In the illustrated embodiment, the secondary winding **84** is connected to the conductor **54** however if the conductor **54** is formed by an integrated circuit element, the winding **84** can be connected externally of the integrated circuit.

The signal circuitry output device comprises an output transformer **86** having a primary winding **88** connected between the network **12** and the output junction **64,** and a secondary or output, winding **90** which is in turn connected to suitable signal utilization circuitry generally designated at **92.**

When any path of the network **12** is conducting, a circuit is established through the input transformer secondary **84,** the output transformer primary **88,** and the conducting comparator path. This results in an output signal across the winding **90** to the utilization circuitry **92.** When the selector circuitry has been operated so that none of the paths of the network **12** have a null established across them, or when a null is established across a given comparator path which is conditioned not to conduct, a circuit through the windings **84, 88** cannot be completed and hence no singal is provided to the utilization circuitry **92.**

In the preferred and illustrated embodiment, the actuator **76** and the utilization circuitry **92** are interrelated so that the condition of the selector mechanism **56** effects operation of the utilization circuitry **92.** By this interconnection, the absence of the signal to the utilization circuitry **92** across a comparator path which is conditioned against conduction has the effect of providing the binary "not" to the utilization circuitry.

FIG. **2** illustrates another embodiment of the invention by which circuitry schematically indicated at **100** functions to enable transmission of signals between a master station and a selected one of a number of remote locations. As an example, the circuitry **100** could be used in an intercommunication system by which signals can be transmitted between a master station (for example, one room in an office) and a selected one of a series of remote stations (in other rooms of the office). The system **100** comprises a network **112** of parallel comparator paths of which only three are illustrated at **112***a*–**112***c*, a selection system generally indicated at **114** by which a remote station is selected for communication with the master or central station, and signal circuitry generally indicated at **116** associated with the network **112** and the selection system **114** for the transmission and reception of signals.

The network **112** is electrically similar to the network **12** described in reference to FIG. **1** and each of the paths **112***a*–**112***c* are identical. Accordingly only the path **112***a* is illustrated and described in detail. The path **112***a* comprises a conductor **120***a* having opposite end junctions **122***a*, **124***a* for connection the paths **112***a* across the selection system **114.** The path **112***a* comprises diodes **126***a*, **128***a* which have their cathode electrodes connected to ground through a common impedance element **134***a*. The path **112***a* functions so that when a null is established across the junctions **122***a*, **124***a*, the diodes **126***a*, **128***a* are both forwardly biased thus permitting the path **112***a* to conduct A.C. Whenever the voltage levels with respect to ground at the junctions **122***a*, **124***a* are different, one or the other of the diodes **126***a*, **128***a* is back biased and the path **112***a* is rendered nonconductive to A.C.

The selection system **114** is substantially the same as that described above in reference to FIG. **1** and accordingly like parts are indicated by corresponding primed reference characters and are not further described except in their functional interrelationship with the remaining components of the circuitry **100.**

The signal circuitry **116** comprises a signal transmitting and receiving transformer **140** which is disposed at the master station, and remote signal transmitting and receiving transformers **142***a*–**142***c* which are associated with the comparator paths **112***a*–**112***c*, respectively, of the network **112.** The transformer **140** comprises a winding **144** which is connected to a signal generating and receiving unit **146** which, in the case of an intercommunication system, can be a combination speaker and microphone circuit. The winding **144** is inductively coupled to a winding **148** which is connected in a circuit between the network **112** and the output junction **64'** of the conductor **54'**.

The remote signal transmitting and receiving transformer **142***a*–**142***c* are all identical and accordingly only the transformer **142***a* is described in detail. The transformer **142***a* comprises a winding **150***a* connected to a unit **152***a* like the unit **146.** The winding **150***a* is inductively coupled to a winding **154** which is connected in series between the cathodes of the diodes **126***a*, **128***a*. The winding **154** is provided with a center tap which is grounded through the resistor **134***a* so that the small D.C. currents which flow through the diodes

126*a*, 128*a* to ground via the resistor 134*a* are balanced when a null is established across the path 112*a*.

In order to communicate between the master station and a remote station the actuator 76′ is operated to establish a null across, for example, the comparator path 112*a*. When this has been accomplished the diodes 126*a*, 128*a* are both forwardly biased by a small current which flows through each diode to ground via the resistor 134*a* and the comparator path 112*a* is conductive to A.C. Signals generated by the unit 146 are transmitted via the transformers 140, 142*a* to the unit 152*a* and vice versa so that communications can be had between the master station and the remote station.

Since a differential voltage is applied across the remaining comparator paths 112*b*, 112*c*, the signals which are transmitted between the master station to the transformer 142*a*, at the remote station cannot be received by the transformers 142*b*, 142*c* of the remaining remote stations.

Operation of the actuator 76′ can be controlled in any suitable manner from the master station and/or from any of the remote stations. It should be appreciated that if the circuitry 100 is employed in connection with an intercommunication system the actuator 76′ is operated in a step-wise fashion to establish a null across a given selected comparator path corresponding to the desired remote location.

A circuit of the character disclosed in FIG. 2 can also be utilized to sense conditions at remote locations and when so utilized the actuator 76′ is operated in continuous fashion so that the null is, in effect, scanned across the comparator circuits of the network to quickly monitor the conditions in succession.

FIGS. 3–6 illustrate a collimator or iris unit 200 which, for the purpose of this description, functions to permit visible light to pass through a transparent window. The iris unit 200 is formed by identical assemblies 202, 204 which cooperate to form the aperture through which the light (or electromagnetic radiation of other frequencies) may pass the the size of which aperture is adjustable without requiring mechanically movable aperture forming parts. Since the assemblies 202,204 are identical only the assembly 202 is described in detail.

The assembly 202 comprises a body of liquid crystal material 206 which defines, in effect, a comparator path network through which light is selectively transmitted, and a selection system 208 for selectively determining the location and size of the light transmitting path areas through the material 206. Liquid crystal material 206 has the property of being opaque to visible light when a voltage is established across the material but which is transparent in the absence of a voltage differential applied across it. The liquid crystal material is confined to a volume which has generally rectangular major surfaces and has a relatively small thickness. When equal voltages exist at corresponding locations on the major surfaces of the body 206 the material between these locations is transparent to visible light while the material between other corresponding locations on the major surfaces are opaque if a voltage differential exists between such corresponding locations. The liquid crystal material can be of any suitable type such as the materials referred to in an aritcle by Joseph A. Castellano at page 64 of *Electronics* magazine published July 6, 1970.

The selection system 208 controls the position and size of corresponding locations on the major surfaces of the crystal network material 206 to thus govern the transmission of light to the assembly 202. The selection system 208 comprises electrically resistive transparent conductor sheets 210, 212 which are electrically connected in parallel across a suitable variable voltage D.C. power supply, indicated schematically at 214, and a selector arrangement for determining the locations along the sheets across which a null is located.

The sheets 210, 212 are generally rectangular members having a relatively small thickness which are supported in parallel extending relationship to each other by a dielectric support frame 216 which sealingly extends about their peripheries to maintain them in position and to seal the volume defined between the sheets. The crystal network material 206 is sandwiched between the sheets 210, 212 and maintained in place by the supporting and sealing frame 216.

The opposite end faces of the sheets are covered by end coatings 220 of highly conductive material which are in turn connected to the power supply 214. The coatings 220 permit the currents flowing through the sheets to be distributed uniformly across their ends. The sheets 210, 212 can be formed from any suitable transparent sheet material which is resistively conductive itself or which has a transparent resistively conducting coating applied to the major surface in contact with the liquid crystal material 206. The opposed ends 210*a*, 210*b* of the sheet 210 are connected between the positive and negative terminals of the power supply 214, respectively, while the opposed ends 212*a*, 212*b* of the sheet 212, which correspond to the sheet ends 210*a*, 210*b*, are connected between the negative and positive terminals of the power supply, respectively. Thus currents flowing through the sheets 210, 212 are oppositely directed. The connections to the power supply are made by suitable conductors which extend through the frame 216 and are joined to the respective end coatings 220.

Due to the above described connections to the power supply, the voltage level at the sheet end 210*a* is always positive with respect to the voltage level at the sheet end 210*b* and the voltage at the sheet end 212*b* is always positive with respect to the voltage at the sheet end 212*a*. When the voltages applied across the sheets are the same, a null is established across the confronting major faces of the sheets 210, 212 substantially medially between their ends and along a band indicated at 230 which extends parallel to the ends of the sheets. Since substantially no voltage differential is established across the liquid crystal network body 206 along the null band, the liquid crystal material is rendered transparent along the band. Hence the entire assembly 202 is transparent along the band which is indicated in FIG. 3 at 230.

The selection system 208 is effective to shift the voltage levels applied across the sheets 210, 212 to shift the location of the band 230 to desired locations between the ends of the sheets. The selection system includes potentiometers 232, 234 connected at opposite ends of the sheet 210 which are ganged together by a suitable linkage 236 to operate in the same manner described above in reference to the potentiometers 70, 72 of the memory unit in FIG. 1.

Potentiometers 238, 240 are connected at opposite ends of the sheet 212 to control the voltage level with

respect to ground applied across the plate **212.** The potentiometers **238, 240** are ganged for simultaneous operation by a linkage **242** which is schematically shown. In the illustrated embodiment of the invention, the potentiometer linkages **236, 242** are operated together via a suitable control knob **244** (see FIG. **4**) so that the band **230** is shifted along the assembly as desired.

The assembly **202** could be constructed by replacing the potentiometers **238, 240** with fixed resistors and by providing a low resistance sheet **212** between them. The voltage with respect to ground along the sheet **212** would thus be fixed and substantially constant. Shifting of the voltage along the plate **210** in such a construction enables the band **230** to shift along the assembly.

As noted previously, the power supply **214** is a variable voltage power supply and may be constructed in any suitable manner. The power supply voltage is variable to change the width of the transparent band through the assembly **202.** When the voltage output from the power supply is relatively low, or is cut off entirely, the entire assembly **202** is transparent because no voltage differential is applied across the body of crystal network material **206.** As the power supply voltage is increased, the differential voltage across the crystal material everywhere but at and adjacent the precise null location is increased so that the transparent band **230** becomes increasingly narrower as the power supply voltage is increased. Hence, by changing the applied voltage from the power supply the width of the transparent area of the assembly **202** is effectively governed without requiring complicated mechanically adjustable iris forming parts. The power supply voltage can be controlled by a suitable knob **246** linked to the power supply.

The assembly **204** is identical to the assembly **202** and therefore is only partially shown. Parts of the assembly **204** which are the same as parts described above are therefore indicated by corresponding primed reference characters. The assembly **204** differs from the assembly **202** only in that the sheets **210', 212'** of the assembly **204** are oriented at 90° with respect to the sheets **210, 212** of the assembly **202.** Thus the transparent band **230'** extending through the assembly **204** extends at right angles with respect to the transparent band **230** of the assembly **202.** The assemblies **202, 204** are juxtaposed, as illustrated in FIG. **6,** the area of intersection of the bands **230, 230'** forms a square or rectangular aperture in the form of a transparent window **260** which permits light to pass through the unit **200.** A thin transparent insulator **250** is disposed between the assemblies to isolate the sheets **212** and **210'** of the adjacent assemblies. The frame **216** extends about both assemblies to maintain them in position with respect to each other.

By controlling the variable power supplies of the assemblies **202, 204** in the manner described above the area and shape of the aperture is readily varied. The linkages **236, 242** and **236', 242'** of the assemblies **202, 204** are independently operated so that the bands **230, 230'** can be shifted in directions transverse to their extents. This enables the apertures to be shifted to any desired location on the iris unit.

FIG. **4** illustrates the iris unit **200** with the assemblies juxtaposed. The window **260** of the iris unit **200** is defined by the area of intersection of the transparent bands **230, 230'** of the assemblies. The four corner areas of the iris unit are those in which opaque portions of both the assemblies **202, 204** overlie each other.

FIG. **5** illustrates the iris unit **200** in a condition in which the power supply voltages of each of the assemblies is reduced relative to the power supply voltage which is applied in FIG. **4** and the area of the window **260** is increased accordingly.

While three embodiments of the present invention have been illustrated and described herein in considerable detail the present invention is not to be considered limited to the precise constructions shown. Other adaptations, modifications and uses of the invention may occur to those skilled in the art and it is the intention to cover all such adaptations, modifications and uses which come within the scope or spirit of the appended claims.

What is claimed is:

**1.** In a system for transmitting perceptible signals:

a. first resistive conductor means;

b. second conductor means;

c. electric power supply means connected to said first and second conductor means;

d. signal transmitting means defined by a plurality of separate parallel paths electrically connected between said first and second conductor means, said paths connected to said first conductor means at electrically spaced locations and each comprised of electrically responsive means rendered effective to transmit information in response to the application of substantially zero voltage differential across such path; and,

e. selector means cooperatively related with said power supply means and at least one of said conductor means for selectively applying substantially zero voltage differentials across selected ones of said paths.

**2.** A system as claimed in claim **1** further including signal means defining a source of information for transmission by individual ones of said path when such paths are rendered conductive.

**3.** A system as claimed in claim **2** further including a plurality of control means each associated with a respective parallel path, each of said control means governing the ability of its respective path to transmit a signal from said signal means when said path is rendered effective.

**4.** The system claimed in claim **2** wherein said signal means comprises second electrical power supply means connected in a circuit across said paths, said circuit for said second power supply means being completable only through those paths which are rendered effective to transmit signals, and output means for detecting completion of a circuit across said second power supply means.

**5.** The system claimed in claim **4** further comprising conditioning means associated with respective ones of said paths for controlling the conduction of a respective path which is rendered effective to transmit signals, said conditioning means having a first condition wherein a circuit through said respective path is interrupted when said path is rendered effective and a second condition wherein said respective path is conductive when rendered effective.

**6.** The system claimed in claim **4** wherein said second power supply means comprises an alternating current source and said output means comprises at least an element for detecting alternating current power in a cir-

cuit connected across said second power supply means.

**7.** A system as claimed in claim **1** wherein said power supply means comprises a D.C. power supply, and said selector means comprises an impedance element connected in circuit with said D.C. power supply means and said first conductor means, and mechanism for varying the impedance of said element.

**8.** The system claimed in claim **1** wherein said first and second conductors comprise transparent sheets and said signal transmitting means comprises a body of liquid crystal material, said sheets disposed on opposite sides of said body of liquid crystal material to define a radiation transmitting assembly wherein signals in the form of radiation are passed through the assembly along paths extending through said conductors and said liquid crystal material, said power supply means providing a substantially steady state voltage across each of said sheets.

**9.** The system claimed in claim **8** wherein the voltage across said sheets provides a transparent band extending across said sheets and through said liquid crystal material to enable electromagnetic radiation to pass through said sheets and crystal material along said band.

**10.** The system claimed in claim **9** wherein said selector means is effective to shift the location of said band relative to said sheets and crystal material.

**11.** The system claimed in claim **10** wherein said power supply means includes structure for providing a variable voltage output for adjustably controlling the width of the band.

**12.** The system claimed in claim **8** further comprising a second radiation transmitting assembly juxtaposed with said first assembly, said second assembly comprising first and second transparent sheet-like conductors having a body of liquid crystal material interposed between them, power supply means for producing a substantially steady state voltage across each of said conductors of said second assembly, said first and second assemblies oriented with respect to each other so that the radiation transparent bands extend in directions transverse to each other to produce a radiation transparent aperture through said first and second assemblies.

**13.** The system claimed in claim **12** further comprising second selector means associated with said second assembly, said first and second selector means operable to shift the positions of the respective radiation transmitting bands relative to said assemblies to adjustably change the location of said aperture relative to said assemblies.

**14.** In a system for selectively transmitting information:

a. means defining an electric power supply;
b. first resistive conductor means connected across said power supply means;
c. second conductor means connected across said power supply means;
d. means defining a plurality of parallel information transmitting paths electrically connected between said first and second conductor means, said paths connected to said first conductor means at electrically spaced locations;
e. each of said paths individually rendered effective to transmit information only when the power supply voltage applied across such path between said first and second conductors is substantially zero; and,
f. selector means cooperatively related with said power supply means and at least one of said first and second conductor means for changing the power supply voltages applied across said paths so that said paths are selectively and individually rendered effective to transmit information.

**15.** The system claimed in claim **14** further comprising means for transmitting information between said conductors via only said paths which are rendered effective.

**16.** The system claimed in claim **15** wherein said means for transmitting information provides for the passage of electromagnetic energy through said paths which are rendered effective.

**17.** The system claimed in claim **14** wherein said power supply means comprises a D.C. power supply and said paths each comprise at least a circuit element having a variable impedance to the passage of electromagnetic energy via said path, said circuit element having a first impedance when substantially zero power supply potential is applied across said path and a substantially different impedance when a power supply voltage differential is applied across said path.

**18.** The system claimed in claim **17** wherein said at least one circuit element comprises first and second oppositely poled diodes for preventing the flow of direct current through said path when a D.C. voltage is applied across said path.

**19.** The system claimed in claim **18** further comprising A.C. power supply means connected in a circuit across said paths, said diodes having their anode electrodes connected to said conductors respectively and their cathode electrodes connected to ground, said diodes ineffective to prevent transmission of A.C. power through a path having a substantially zero D.C. power supply voltage applied thereacross.

**20.** In a system for selectively transmitting information:

a. first and second conductor means;
b. source means providing a source of operating medium flow potential to said conductors;
c. a plurality of information transmitting paths connected in parallel across said conductors; said paths each comprising at least an element rendered effective to enable medium flow through the path in response to the establishment of substantially zero source means flow potential across said path between said conductors;
d. one of said conductors having a finite extent, said paths connected to said one conductor at spaced locations along said extent and said one conductor constructed to provide impedance between said locations;
e. means for changing the potential along said one conductor whereby substantially zero potential is selectively established across said paths;
f. second source means effective to enable transmission of information via a path in which said element is rendered effective; and,
g. output means operated in response to transmission of information via a path in which said element is rendered effective.

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