

Jacob et al.

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[54] **TOUCH SWITCH ARRAY PANEL**

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[51] **Int. Cl.**.....**H01h 9/16**

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340/365 C, 258 C, 337, 21

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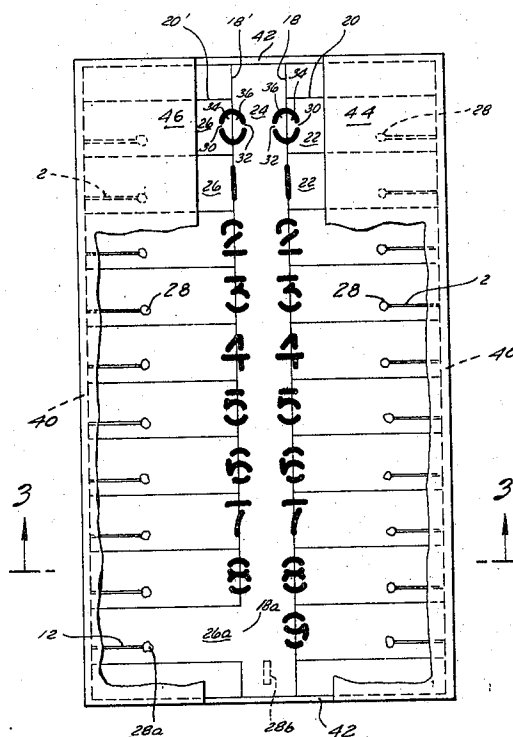
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[57]

ABSTRACT

A panel for an array of touch switches is defined by separated but adjacent conductive sections mounted on a support panel, a set of first switch sections, each constituting a contact for a selected one of the number of switches involved, being arranged on the panel in a given direction and a second and elongated switch section, corresponding to a contact common to all of the switches, being arranged on the panel so as to extend alongside but spaced from the set of first sections. The lines separating the second section from the individual first section may be in the form of indicia such as numbers, and where those indicia are of appreciable width their central portions are formed of conductive subsections which are parts of one or more of the conductive sections corresponding to the particular switch involved. The supporting panel may be light-transmissive, while the conductive sections may be substantially opaque, and particularly when the lines of separation are in the form of indicia, illuminating means may be provided on the underside of the support panel, thereby to provide for illumination of the lines defining the indicia corresponding to the particular switch actuated at any given time.

26 Claims, 4 Drawing Figures



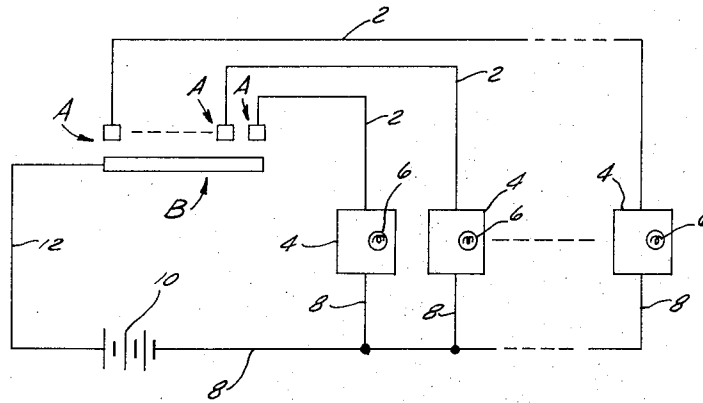
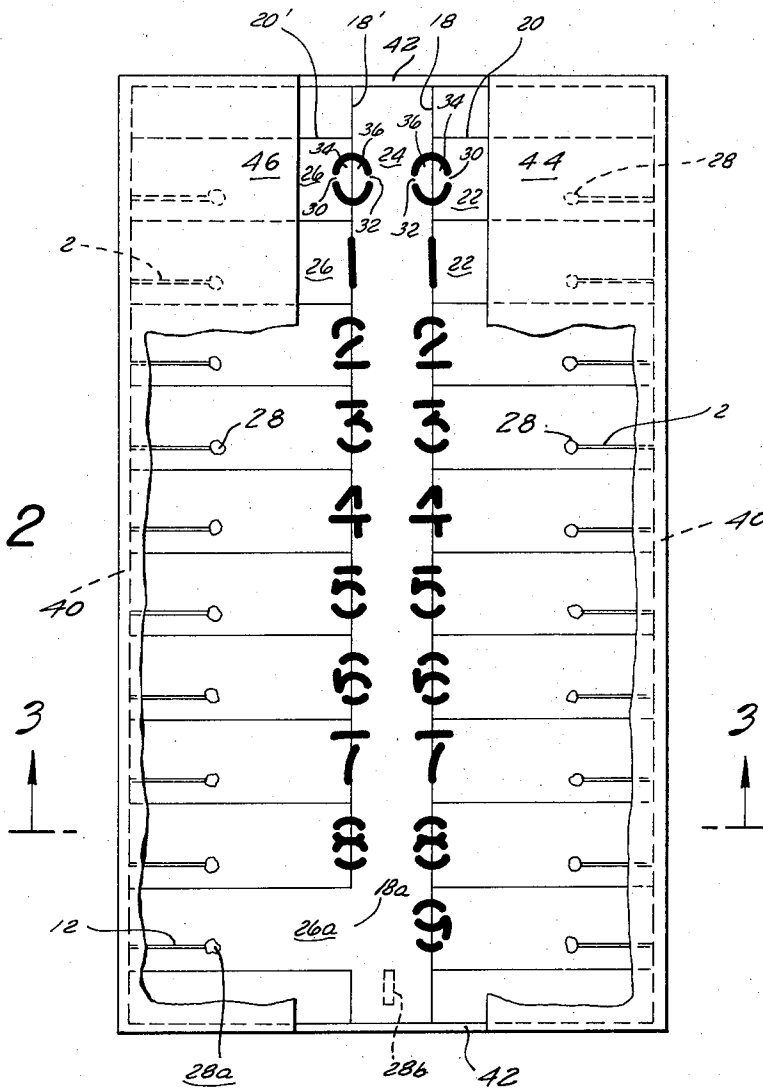


FIG. 1

FIG. 2



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FIG. 3

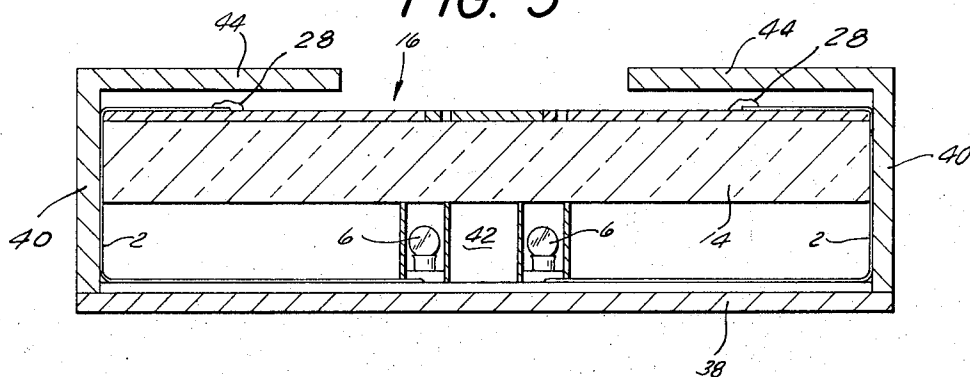
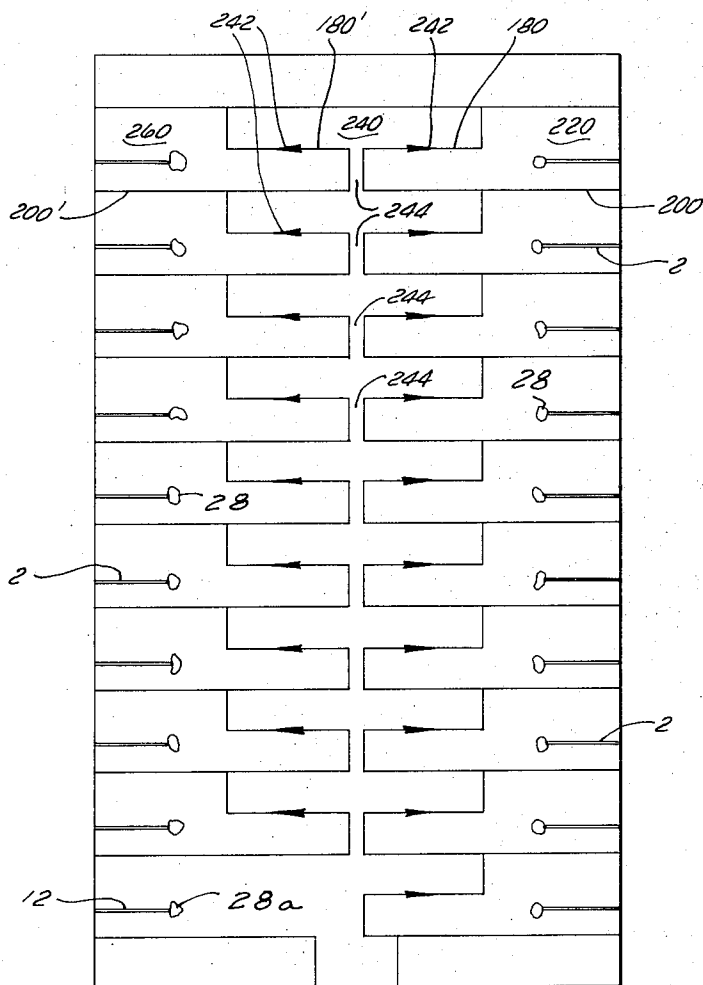


FIG. 4



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TOUCH SWITCH ARRAY PANEL

The present invention relates to the construction and arrangement of a switch panel specially adapted for use in conjunction with an array of touch switches. The arrangement is particularly well adapted for incorporation into a touch switch panel for use in digital tuning of communication receivers such as television receivers.

So-called touch switches are known in the art. They comprise panelboards or the like having conductive sections which, when touched by the finger of an operator, are appropriately electrically modified so as to actuate external circuitry. In one type of touch switch the touching of the switch modifies some electrical characteristic between a conductive switch section and ground, e.g., its capacitance to ground. In another type of touch switch the finger of the operator actually electrically bridges a space between a pair of conductive sections, thereby to provide a conductive path therebetween which, although of relatively high resistivity, is nevertheless sufficiently conductive to cause the actuation of appropriate control circuitry. The present invention is adaptable for use with both of these types of touch switches as well as other types of touch switches, but it is here specifically disclosed in conjunction with a resistive type of touch switch, one in which the finger of the operator actually defines a resistance between a pair of separated conductive sections.

Touch switches, as well as switches generally, are often provided in arrays designed to selectively control a plurality of external circuits, and in many instances the external circuits being controlled are identified by appropriate indicia, such as numbers. Indeed, in the case of the tuning of a communication receiver such as a television set to one channel or another, the channels being identified by numbers, it is appropriate and convenient for the switches controlling the tuning to each individual channel to be identified by indicia corresponding to the number of that particular channel. Conventionally, such indicia are provided on the switch panel by applying numbers thereto in a manner separate from the specific structure employed for effecting the switching operation. In some instances means have been provided for selectively illuminating the particular number corresponding to the actuated switch, thereby to indicate to the operator which switch is, at any given moment, under actuation. This is a highly desirable arrangement but one which, insofar as the prior art is concerned, has required the use of structure and elements separate and distinct from the switching mechanism in order to achieve indicia identification. This is a source of expense both with regard to material costs and assembly operations.

In addition, the touch switches themselves have required individual assembly and construction, thereby contributing appreciably to the overall cost not only of the switching mechanism but also of the entire apparatus with which that switching mechanism is employed.

It is the primary object of the present invention to devise a touch switch panel construction which is inexpensive to manufacture and extremely reliable in operation.

It is another prime object of the present invention to devise such a switch panel in which the respective con-

ductive sections are arranged in a manner facilitating individual switch actuation and formation.

It is a further object of the present invention to devise such a switch panel in which the indicia identifying the several switches are formed as an inherent part of the switch structure, so that no separate operations or structure are required to provide for such indicia identifying the individual switches.

It is yet another object of the present invention to devise such a switch panel in which, when the indicia are of appreciable width, the construction and arrangement of the indicia is such as to ensure proper switch actuation when the indicia are touched.

It is a still further object of the present invention to devise a switch panel with integrally formed indicia thereon which is of a type well adapted for use in conjunction with illumination means designed to illuminate the particular indicia corresponding to the then-actuated switch.

It is a still further object of the present invention to devise a switch panel which is specially well suited for digital switch operation and indication and, indeed, for such digital actuation and operation where both tens and units are involved.

In accordance with the above, the switch panel of the present invention comprises a support, preferably in the form of a translucent insulating panel or plate, the upper surface of which carries a set of first conductive sections or strips each corresponding to one of the external switching circuits to be actuated, these first conductive sections being insulated or separated from one another and being arranged on the upper surface of the support panel in a particular direction. Also provided on that surface is a second conductive section, elongated so as to extend alongside but insulated or spaced from the set of first sections above described. This second section is designed to constitute a terminal common to all of the switches. Means are provided for making electrical connections to the second or common conductive sections and to the individual first sections. If the operator with his fingertip bridges the gap between the second section and a particular first section, then an appropriate switching or control means electrically connected between the second or common section and that particular first section will be actuated, thereby to perform a desired function, such as controlling the tuning circuit of a television receiver.

In its preferred form the lines of separation between the individual first sections and the common section are so configured as to define indicia corresponding to or identifying the individual first sections concerned. Those indicia may, for example, be in the form of consecutive numbers. Since the indicia themselves, as defined by the lines of separation between the corresponding sections, are a part of the switch structure per se, it will be apparent that no special indicia-applying step is required. Also, since the indicia inherently occur at the very line of separation between the common second section and the particular first section of interest, if the operator touches the desired indicia he will thus automatically have his finger in the proper place to actuate the touch switch in question.

It is sometimes occurs that the indicia is of appreciable width. This is true, for example, for the numeral "0". If the operator were to touch the indicia only in its

central portion, and if that central portion were to be insulated or separated from or otherwise not operatively connected to the appropriate conductive switch sections, then the switch might not be actuated. Accordingly, with indicia of the type here under discussion the lines defining the periphery of that indicia are provided with gaps and the center of the indicia is defined by a conductive section which is electrically connected to one or more of the switch sections proper by the gaps in the peripheral indicia lines. In this way it is ensured that a touch in the middle of the indicia will nevertheless reliably actuate the corresponding touch switch.

When decade switch operation is desired, using both "units" and "tens" switches, the same common second conductive section may be employed both for the "unit" switches and the "tens" switches, with the series of sections corresponding to the "units" switches being disposed on one side of the common conductive section and the series of switch sections corresponding to the "tens" switches being disposed along the other side thereof.

The construction in question is exceedingly easy to manufacture, as by conventional printed circuit techniques. The operative surface of the support panel can be provided with a conductive sheet or foil, and then the appropriate lines of separation and of indicia-formation can be etched from that sheet or foil, as by a conventional photolithographic and etching technique, thereby to produce an integral panel of the type in question. In this way even quite elaborate indicia can be produced on a mass scale with great accuracy and at exceedingly low cost.

The support panel may be formed of a light-transmissive material, while the conductive sections may be essentially opaque. The lines of separation between the conductive segments, including particularly the lines defining the appropriate indicia, will expose the light-transmissive support panel. As a result, if illuminating means is disposed beneath the support panel and appropriately actuated, each time that a given touch switch is energized the appropriate indicia on the switch panel will be illuminated.

In accordance with the present invention the individual sections defining the touch switches may be variously shaped and configured, the photolithographic technique used in forming the switch panelboard permitting a very wide variety of modifications in the particular shapes and arrangements of the conductive sections.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to the construction and arrangement of a touch switch array panel as defined in the appended claims and as described in this specification, taken together with the accompanying drawings, in which:

FIG. 1 is a schematic circuit diagram generically illustrating the type of switch array involved and the action of the switches of that array on external circuitry;

FIG. 2 is a top plan view, partially broken away, of an embodiment of the switch panel of the present invention as specifically designed for the digital tuning of a television receiver in the UHF band, the panel being designed to actuate pairs of "units" and "tens" switches which in combination define numbers from

"0" to "89", this being but one application to which the present invention is adapted;

FIG. 3 is a cross sectional view taken along the line 3—3 of FIG. 2; and

FIG. 4 is a top plan view of an alternative switch panel with conductive sections differently configured from those in the switch panel of FIG. 2.

Turning first to FIG. 1, which generically illustrates the electrical arrangement and operation of a plurality of touch switches in connection with which the present invention is here illustrated, those switches are shown as comprising a series of contacts A, each electrically connected by a lead 2 to one end of an external utilization circuit 4 which may, as specifically illustrated, include an illuminatable bulb 6 as well as any other appropriate control and actuating apparatus or circuitry, such as might, for example, be involved in effecting the tuning of a television receiver. The other end of the utilization circuit 4 has a lead 8 extending therefrom, that lead 8 going to one terminal of a battery or other electrical source 10. The other terminal of that battery is connected by leads 12 to a terminal B which is common to all of the touch switches. The terminals A are all separated or insulated from one another and from the terminal B, but they are all located close to the terminal B. If now a given utilization circuit 4 is to be actuated, the operator will place his finger so as to bridge the gap between the common terminal B and the particular terminal A connected to that utilization circuit 4 actuation of which is desired. The electrical effect of the operator's finger, as by constituting a relatively low resistance between the terminal B and the selected terminal A, will cause a circuit to be completed through the selected utilization circuit 4 to actuate the latter. This type of circuit arrangement and switch construction is known, and is here illustrated only to show an area of application for the structure of the present invention.

In accordance with the present invention, the switch array comprising the individual terminals A and the common terminal B is formed by a support panel 14 of insulating material which, for reasons which will become apparent hereinafter, is preferably of light-transmissive material. Many suitable synthetic plastics are known to have these characteristics. Secured to the upper surface of the support panel 14 in any suitable fashion, as by the use of an appropriate adhesive, is a conductive sheet or foil generally designated 16. Initially that sheet or foil 16 is deposited in an unbroken fashion so as to cover all of the appropriate portion of the upper surface of the support panel 14. Thereafter, as through a conventional photolithographic and engraving technique such as is commonly used in the making of printed circuits, portions of the sheet or foil 16 are etched away to define lines of separation between various portions of the conductive sheet 16, thereby to produce individual separated conductive sections. In particular, and having reference first to the embodiment of FIGS. 2 and 3, there is provided on the right hand side of the sheet 16 a generally vertical etched-out separating line 18 extending generally from top to bottom thereof and a series of generally horizontally extending etched-out separating lines 20 extending from the line 18 to the right hand side edge of the sheet 16. Another vertically extending line 18' is pro-

vided positioned to the left of the line 18, and horizontally extending lines 20' extend out to the left from the line 18' to the left hand side edge of the sheet 16. This produces a first set of conductive sections 22 on the right hand side of the panel, those sections 22 being separated from one another and arranged vertically along the length of the panel. Also produced is a second elongated conductive section 24 substantially centrally located on the panel and extending vertically thereon alongside and closely adjacent, but separated from, the sections 22. In addition a left hand set of third sections 26 are formed, similar to the sections 22 but disposed on the opposite side of the central elongated section 24 from the sections 22. The section 24 corresponds to the common terminal B of the touch switch array of FIG. 1, while the sections 22 and 24 correspond to the individual terminals A of the circuitry of FIG. 1.

Means are provided for making electrical connections to the sections 22, 24, and 26 respectively. These connection means may take any convenient form. As here disclosed individual connection points, semi-schematically represented by the areas 28, are provided on each section involved, to which connection points leads (corresponding to the leads 2 and 12 in the circuit of FIG. 1) may be connected. In the form specifically shown in FIG. 2 it will be noted that the line 18' is interrupted at 18a, so that the section 26a is electrically connected to the conduction section 24. Consequently the connection point 28a on the conductive section 26a is the one to which the lead 2 is adapted to be connected, thereby to make electrical connection with the common conductive section 24 corresponding to the common terminal B. This procedure is used only to provide for symmetry of electrical connection; if desired the line 18' could be continuous, in which case a separate connecting means 28b, shown in dotted lines in FIG. 2, would be provided on the elongated conductive section.

The lines defining the elongated central conductive section 24 need not be in straight line form, as shown in FIG. 2. They may, for example, be sinuous, as evidenced by the lines 180 and 180' of FIG. 4, which sinuous lines, in conjunction with horizontal lines 200 and 200', define a first or right hand set of conductive sections 220, a central conductive section 240 which extends alongside all of the sections 220, and a left hand set of conductive sections 260, to which, as shown, connection means 28 are provided, with leads 2 or 12, as the case may be, extending. In this regard the embodiments of FIGS. 2 and 4 are but exemplary, and it will be understood that the particular configurations of the lines separating the various conductive sections can be very widely varied. Indeed, it is a particular advantage of the arrangement of the present invention that such a wide latitude of section configuration is available.

Returning to the embodiment of FIG. 2, it will be noted that the separation between the common elongated conductive section 24 and each of the other conductive sections 22 or 26 is defined not only by the line 18 or 18', as the case may be, but also by other lines formed in the sheet or foil 16 by etching away the material thereof which other lines define identifying indicia. The lines separating the elongated section 24

from the individual conductive sections 22 define the numerals 0 - 9, and the lines separating the elongated section 24 from the sections 26 define the numerals 0 - 8, the former row of numerals representing "units" and the latter row of numerals representing "tens" in a decade type of indication. These indicia lines, it will be noted, are formed by etching away the appropriate portions of the sheet or foil 16 at the same time that the remainder of the lines 18, 20, 18' and 20' are formed. Indeed, the indicia 1 actually represents a portion of the line 18 or 18', preferably somewhat thickened in order to make it stand out. Consequently the indicia are made at the same time and by means of the same operation as the switch terminals themselves, and hence they are positively provided in the proper places and without requiring any special fabrication and assembly operations.

Most number indicia are of appreciable thickness.

The number "0" may be taken as typical. If the operator were to place his finger only in the center of the zero, and if the line defining the "0" were continuous, he might then not effectively bridge the gap between the terminal 24 and the terminal 22 or 26. In order to avoid this possibility of malfunction the lines defining the zeros are provided with gaps at 30 and 32, and the center of the zero is filled by conductive material separated into two conductive subsections 34 and 36. The subsections 34 and 36 are separated from one another by the line 18, the subsection 34 is connected to the terminal 22 by the conductive material defining the gap 30, and the subsection 36 is connected to the terminal 24 by the conductive material defining the gap 32. If now the operator touches only the center of a given zero indicia, he will nevertheless bridge the gap with his finger between the subsections 34 and 36, and this will electrically be the same as bridging the gap directly between the sections 22 and 24. Consequently the appropriate switch will be actuated.

It will be noted that gaps are provided in the lines defining all of the other numbers in order to achieve the same results as have been described in detail with regard to the indicia "0". Only the numbers "1" are not provided with such gaps, because those numbers are of such narrow width that the problems involved in touching only the center of the number are not presented.

As may be seen from FIG. 3, the support panel 14, with the various conductive sections thereon, may be mounted in any appropriate manner within a housing defined by a bottom wall 38, side walls 40, end walls 42, and top wall sections 44 and 46. The top wall sections 44 and 46 do not extend completely across the upper surface of the switch panel. They do extend sufficiently across that upper surface so as to hide from view and protect from damage the electrical connection means 28 and the leads connected thereto. They expose the lines of separation 18 and 18' between the elongated central conductive section 24 and the vertically arranged sets of conductive sections 22 and 26 respectively, thereby to provide access to those lines of separation so that the operator can place his finger where he desires in order to actuate the appropriate switch. Individual illuminating means, such as the bulbs 6 schematically indicated in FIG. 1, may be provided in the housing beneath the translucent panel 14 and

respectively in registration with the indicia corresponding to the particular utilization circuits 4 of which the bulb 6 is a part. With this arrangement, when a particular switch is actuated by bridging the gap between the conductive section 24 and the other appropriate conductive section 22 or 26, the lamp 6 immediately below the indicia provided at that area of contact separation, which indicia correspond to the particular switch involved, will be illuminated, making it evident to the operator not only that a switch has been actuated but also which particular switch, identified by number, has been actuated. When decade switching is employed, using both "units" and "tens" indications, the operator will touch one indicia in the "units" column and one indicia in the "tens" column, thereby to energize the work means corresponding to a particular conductive section 22 and a particular conductive section 26, and the corresponding indicia both in the "unit" and "tens" columns will be illuminated to indicate what pair of switches has been actuated.

The electrical connection areas 28 and 28a are shown in the drawings more or less schematically. They may simply be areas of the conductive sheet to which the ends of the leads 2 and 12 may be physically and electrically secured by means of solder, and they are specifically thus illustrated. Where electrical connection is to be made to the panel of the present invention by means of other printed circuit panels the areas 28 and 28a may represent etched-away portions of the sheet serving as guides or templates for the subsequent aperturing of the insulating support panel 14, projecting portions of the printed circuit panel to which electrical connection is to be made being adapted to extend through those apertures and to carry conductive layers on their outer faces which can be solder-connected to the conductive surfaces on the switch array panel. It will be understood that these are but exemplary of many different ways in which appropriate electrical connection can be made to the conductive surfaces in question.

In the embodiment of FIG. 4 the indicia are schematically shown in the form of arrowheads 242 located on one of the lines which separate the common elongated conductive section 240 from a given individual conductive section 220 or 260. These indicia 242 may be in the form of numbers, as shown in FIG. 2, letters, or any other symbols, and they are located at points appropriate for the actuation of the individual switches defined by the conductive sections 220 and 260 respectively. One special advantage of the configuration shown in FIG. 4 is that if the operator places his finger at the spaces 244 located at the narrowest portions of the common elongated conductive section 240, he can simultaneously actuate a pair of switches defined by the central common conductive section 240 and an opposed pair of individual conductive sections 220 and 260 or, if only one switch at a time is to be actuated, the array will be touched at the locations where the arrowhead indicia 242 are located.

Thus an exceptionally simple arrangement has been provided for obtaining an array of touch switches and identifying the particular switches in question. Both the switch structure and the identifying arrangements are simultaneously formed in a simple and virtually foolproof manner. The switch operation is likewise reliable

and foolproof, and the arrangement and construction lends itself to the making of switch arrays of many different types and designs.

While but a limited number of embodiments of the present invention have been here specifically disclosed, it will be apparent that many variations may be made therein, all within the scope of the invention as defined in the following claims.

I claim:

1. A touch switch panel comprising a support having a surface, a plurality of physically and electrically separated first conductive sections arranged in a given direction of said support surface, a second elongated conductive section on said support surface extending alongside and spaced from said first sections, and means for making separate electrical connections to said first sections respectively and to said second section.
2. The panel of claim 1, in which said second section is separated from said first sections respectively by lines shaped to form indicia corresponding to said first sections respectively.
3. The panel of claim 2, in which said indicia comprise numbers.
4. The panel of claim 3, in which said numbers are consecutive along the length of said second section.
5. The panel of claim 2, in which at least some of said indicia are of appreciable width with a central opening, said central opening being defined by a part of at least one of the adjacent sections, connected to its corresponding section proper by a break in the line defining the periphery of said indicia.
6. The panel of claim 2, in which at least some of said indicia are of an appreciable width with a central opening, said central opening being defined by two separated conductive subsections which are respectively parts of said second section and the associated first section, said subsections being connected to their corresponding sections proper by breaks in the line defining the periphery of said indicia.
7. In the panel of claim 1, a plurality of separated third conductive sections arranged in said given direction on said support surface alongside and spaced from said second section and on the other side of said second section from said first sections, and means for making electrical connections to said third sections respectively.
8. The panel of claim 7, in which said second section is separated from said first sections respectively by lines shaped to form indicia corresponding to said first sections respectively.
9. The panel of claim 8, in which said indicia comprise numbers.
10. The panel of claim 9, in which said numbers are consecutive along the length of said second section.
11. The panel of claim 8, in which at least some of said indicia are of appreciable width with a central opening, said central opening being defined by a part of at least one of the adjacent sections, connected to its corresponding section proper by a break in the line defining the periphery of said indicia.
12. The panel of claim 8, in which at least some of said indicia are of an appreciable width with a central opening, said central opening being defined by two separated conductive subsections which are respective-

ly parts of said second section and the associated first section, said subsections being connected to their corresponding sections proper by breaks in the line defining the periphery of said indicia.

13. The panel of claim 2, in which said support surface is light-transmissive, said conductive sections are substantially opaque, the spaces between said sections exposing said support surface, and individually actuatable illuminating means mounted in registration with said indicia respectively on the other side of said support surface from said sections.

14. The panel of claim 5, in which said support surface is light-transmissive, said conductive sections are substantially opaque, the spaces between said sections exposing said support surface, and individually actuatable illuminating means mounted in registration with said indicia respectively on the other side of said support surface from said sections.

15. The panel of claim 6, in which said support surface is light-transmissive, said conductive sections are substantially opaque, the spaces between said sections exposing said support surface, and individually actuatable illuminating means mounted in registration with said indicia respectively on the other side of said support surface from said sections.

16. The panel of claim 8, in which said support is light-transmissive, said conductive sections are substantially opaque, the spaces between said sections exposing said support surface, and individually actuatable illuminating means mounted in registration with said indicia respectively on the other side of said support surface from said sections.

17. The panel of claim 1, in which said conductive sections comprise conductive sheet parts adhered to said support surface, the separations between said sections being defined by areas etched away from said conductive sheet.

18. In combination with the panel of claim 1, a housing at least partially enclosing said panel and covering a portion of the section-carrying surface thereof, and exposing on that surface substantially only the area thereof where said second section is adjacent the other

sections.

19. In combination with the panel of claim 2, a housing partially enclosing said panel and covering a portion of the section-carrying surface thereof, and exposing substantially only that area of said surface where said indicia-forming lines exist.

20. In combination with the panel of claim 5, a housing partially enclosing said panel and covering a portion of the section-carrying surface thereof, and exposing substantially only that area of said surface where said indicia-forming lines exist.

21. In combination with the panel of claim 6, a housing partially enclosing said panel and covering a portion of the section-carrying surface thereof, and exposing substantially only that area of said surface where said indicia-forming lines exist.

22. In combination with the panel of claim 8, a housing partially enclosing said panel and covering a portion of the section-carrying surface thereof, and exposing substantially only that area of said surface where said indicia-forming lines exist.

23. In combination with the panel of claim 13, a housing partially enclosing said panel and covering a portion of the section-carrying surface thereof, and exposing substantially only that area of said surface where said indicia-forming lines exist.

24. In combination with the panel of claim 14, a housing partially enclosing said panel and covering a portion of the section-carrying surface thereof, and exposing substantially only that area of said surface where said indicia-forming lines exist.

25. In combination with the panel of claim 15, a housing partially enclosing said panel and covering a portion of the section-carrying surface thereof, and exposing substantially only that area of said surface where said indicia-forming lines exist.

26. In combination with the panel of claim 16, a housing partially enclosing said panel and covering a portion of the section-carrying surface thereof, and exposing substantially only that area of said surface where said indicia-forming lines exist.

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