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ELECTRICAL SIGNAL GENERATING APPARATUS

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Fig. 1.

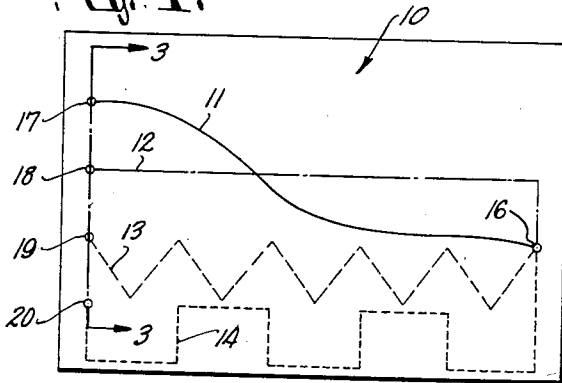


Fig. 2.

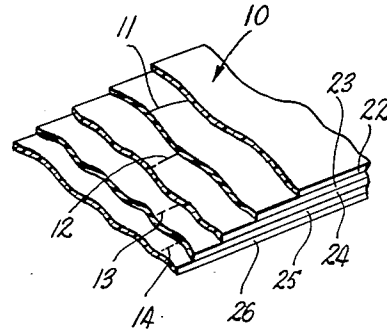


Fig. 3.

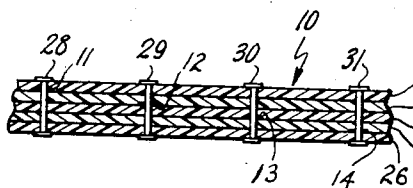


Fig. 4.

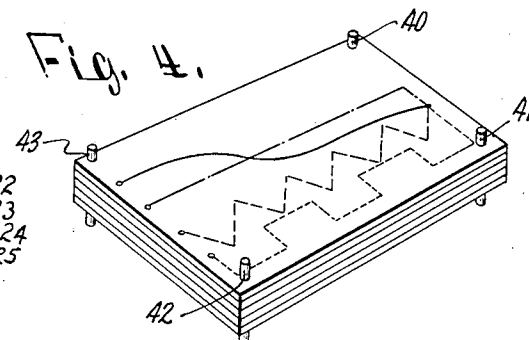
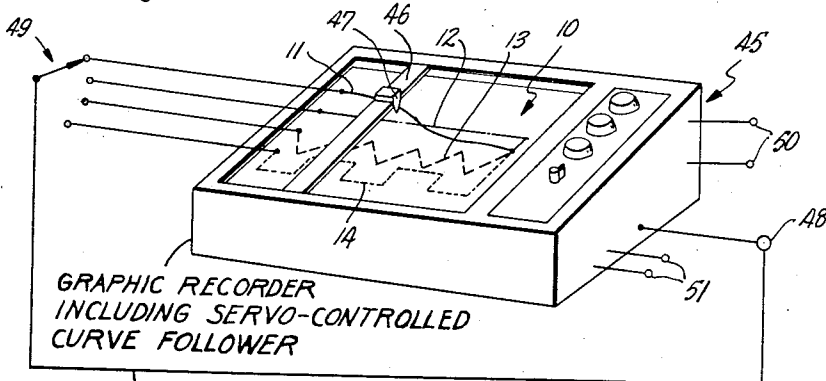


Fig. 5.



GRAPHIC RECORDER
INCLUDING SERVO-CONTROLLED
CURVE FOLLOWER

ALTERNATING
CURRENT
SIGNALS

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ELECTRICAL SIGNAL GENERATING APPARATUS

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5 Claims. (Cl. 340—166)

This invention relates to apparatus for generating electrical signals and more particularly to apparatus for generating electrical signals representing a selected function of one variable with respect to another variable.

In conjunction with automatic curve following apparatus, it is well known to generate electrical signals which represent the function of one variable with respect to another variable by energizing an electrical conductor having a spatial configuration corresponding to the relationship between the variables and following the energized electrical conductor with a probe which is controlled by a servo system. The servo system may be arranged to maintain the probe in alignment with the conductor and to generate electrical signals in accordance with the position of the probe.

Automatic curve following apparatus of the type described above is frequently employed to generate signals representing complex relationships between variables which cannot be produced readily by conventional electrical circuit components. However, where several different signals are to be generated by means of a single piece of curve following apparatus, it has been necessary to mount each conductor on a separate sheet, and to substitute sheets each time a different signal is to be generated.

In accordance with the present invention, several electrical conductors are each arranged in a spatial configuration defining the relationship between one variable and another variable, the conductors are insulated from each other, each conductor is held in a plane which is parallel and adjacent to the planes in which each of the other conductors are confined, and means are provided for energizing selectively each of the conductors with electrical current. By means of automatic curve following apparatus of the type described above, a probe may be used to follow the energized conductor only, and an electrical signal may be generated corresponding to the spatial configuration of any one of the conductors without substituting sheets in the curve following apparatus.

A better understanding of the invention may be had from the following detailed description when taken in conjunction with the drawings, in which:

Fig. 1 is a plan view of a matrix constructed in accordance with the principles of the invention;

Fig. 2 is a perspective view of the matrix of Fig. 1 partially broken away;

Fig. 3 is a sectional view of the matrix of Fig. 1 taken along line 3—3 showing the means for making electrical connection to the conductors;

Fig. 4 is a perspective view of an embodiment of the present invention in which the electrical conductors are mounted on interchangeable sheets of material; and

Fig. 5 is a combined block and schematic circuit diagram of an electrical signal generating system including a matrix constructed in accordance with the present invention.

In Fig. 1 there is shown a matrix including a conductor 11, which is represented by a solid line, a con-

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ductor 12, which is represented by a dash-dot line, a conductor 13, which is represented by a dashed line and a conductor 14, which is represented by a dotted line.

In the embodiment of Fig. 1, the conductors 11-14 are electrically connected together at the right hand end of the matrix and a terminal 16 provides a common connection. At the left hand end of the matrix, the conductors 11-14 are brought out to separate terminals 17-20, respectively.

Fig. 2 shows the matrix 10 of Fig. 1, partially broken away. In Fig. 2, the individual sheets 22-26 may be seen. The conductor 11 is held between the top sheet 22 and the second sheet 23, the conductor 12 is held between the second sheet 23 and the third sheet 24, the conductor 13 is held between the third sheet 24 and the fourth sheet 25, and the conductor 14 is held between the fourth sheet 25 and the bottom sheet 26.

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1, illustrating one way in which each of the conductors 11-14 may be brought out to a separate electrical connection. In Fig. 3, a metal rivet 28 passes through the entire thickness of the matrix 10 and engages the conductor 11. Similarly, the rivets 29-31 pass through the matrix 10 and engage each of the other conductors 12-14. The rivets 28-31 may be employed as the terminals 17-20 of Fig. 1.

The matrix 10 may be constructed by taking individual sheets of a thermo-plastic insulating material, forming conductors having desired spatial configurations on each of the sheets, and bonding all of the sheets together by means of heat and pressure. Thus, the conductors 11-14 are each insulated and held in separate parallel planes between the sheets. One method by which the conductors 11-14 may be formed is by painting the conductor in place with conventional conducting paint, and allowing the conductor to dry before assembling the matrix. Other methods which may be used include conventional printed circuit techniques such as plating, etching and bonding strips of foil to the sheets.

Although only four separate conductors have been shown in the embodiment of Fig. 1, it will be appreciated that a matrix may be constructed having either a greater number or a lesser number of conductors.

Fig. 4 illustrates an alternative embodiment of the invention in which the conductors are mounted on interchangeable sheets. With the embodiment of Fig. 4, a library of separate sheets may be made available, from which a matrix of selected ones of the sheets may be temporarily used in the same manner as the matrix 10 of Fig. 1. The individual sheets of the matrix of Fig. 4 may be indexed and held together by means of the index pins 40-43 which pass through matching holes in each of the sheets.

In Fig. 5, the matrix 10 is installed in a conventional graphic recorder 45, including curve following apparatus. The recorder 45 is of the flat bed type in which the matrix 10 is held stationary and a movable carriage 46 supports a probe comprising a pickup coil 47. Included within the recorder 45 is a source of alternating current from which a wave appears at the terminal 48. By means of a switch 49, any one of the conductors 11-14 in the matrix 10 may be energized. The common connection between the conductors 11-14 at the terminal 16 is returned to the source of alternating current inside the recorder 45.

As the carriage 46 is transported along the length of the matrix 10, the pickup coil 47 provides a wave of one phase or of opposite phase depending on its location with respect to the energized conductor. In response to the wave from the pickup coil 47, a servo system included in the recorder 45 moves the pickup

coil 47 into alignment with the energized conductor. By means of a potentiometer or an electrical signal generator linked to the servo system, an electrical signal is provided at the output terminals 50 corresponding to the location of the pickup coil 47.

An electrical signal representing the position of the carriage 46 along the length of the matrix 10 may be obtained by linking a potentiometer or electrical signal generator to the carriage transport mechanism to provide an electrical signal at the output terminals 51.

Thus, the curve following apparatus included in the recorder 45 of Fig. 5 is capable of providing an electrical signal corresponding to any one of several relationships between two variables as defined by the spatial configurations of the conductors 11-14.

Although the apparatus of Fig. 5 and the matrix 10 are designed to provide output signals in accordance with an X-Y coordinate system, it will be appreciated that the invention may be employed where the spatial configuration of the conductors is in other coordinate systems as well.

What is claimed is:

1. Apparatus for generating an electrical signal representing a function of one variable with respect to another variable, including in combination a plurality of electrical conductors, each of which spatially defines a function of one variable with respect to another variable; means insulating each of said conductors from each of the other conductors; means selectively energizing each of said conductors from a source of alternating current whereby an alternating current field is established surrounding the energized conductor; a curve follower adapted to center itself with respect to an alternating current energized conductor; means for transporting the curve follower along one coordinate axis; means connected to the curve follower for causing the curve follower to center itself with respect to the alternating current conductor along a second coordinate axis perpendicular to the first coordinate axis; and means linked to the curve follower for generating an electrical signal in response to the position of the curve follower along the second coordinate axis.

2. A set of separately energizable curves adapted to be used in conjunction with automatic curve following apparatus for selectively generating a plurality of electrical signals representing function of one variable with respect to another variable including in combination a composite structure comprising a plurality of electrical conductors, each of which is confined to a single plane and has a different configuration corresponding to a predetermined function of one variable with respect to another variable to define a curve, a plurality of stacked planar sheets of insulating material interleaved with said plurality of conductors to maintain said conductors in separate parallel planes and insulated from one another,

and means for selectively energizing any one of said plurality of electrical conductors from a source of electrical current.

3. A set of curves for use in automatic curve following apparatus for selectively generating an electrical signal in accordance with the spatial configuration of one of the set of curves including in combination a plurality of electrical conductors, each of which is confined to a single plane and corresponds to the configuration of a predetermined function of one variable with respect to another variable, a plurality of sheets of insulating material interleaved with said conductors to maintain the planes of each of said conductors separate and parallel and to insulate said conductors from one another, means fastening said plurality of sheets in a stack, and switching means coupled to said conductors for energizing any one of the conductors with electrical current.

4. A device for use in conjunction with automatic curves following apparatus in which a probe is movable for generating electrical signals which represent a function defining a curve including in combination a plurality of separate electrical conductors each of which has a unique configuration which spatially defines variations in a first variable with respect to a second variable representing said function, a plurality of planar sheets of insulating material stacked together in a composite structure, each conductor being interleaved between a different adjacent pair of said planar sheets so that each conductor is confined to a separate single plane and insulated from the other conductors, and connections coupled to the opposite ends of the conductors for selectively energizing ones of the conductors from a source of electrical current.

5. A device for use in conjunction with automatic curve following apparatus including in combination a plurality of separate electrical conductors each of which is confined to a single plane and has a unique configuration defining a curve representative of a function having variations in a first variable with respect to a second variable, insulating material arranged between adjacent conductors and coextensive therewith to maintain said planes of the conductors parallel and to electrically insulate each of the conductors from the other, and terminals coupled to the opposite ends of the conductors for receiving currents for the energization of the conductors.

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