July 4, 1944. D. J. OLDENBOOM 2,353,061

CIRCUIT CONNECTING DEVICE

Filed Oct. 29, 1940

Fig. 1.

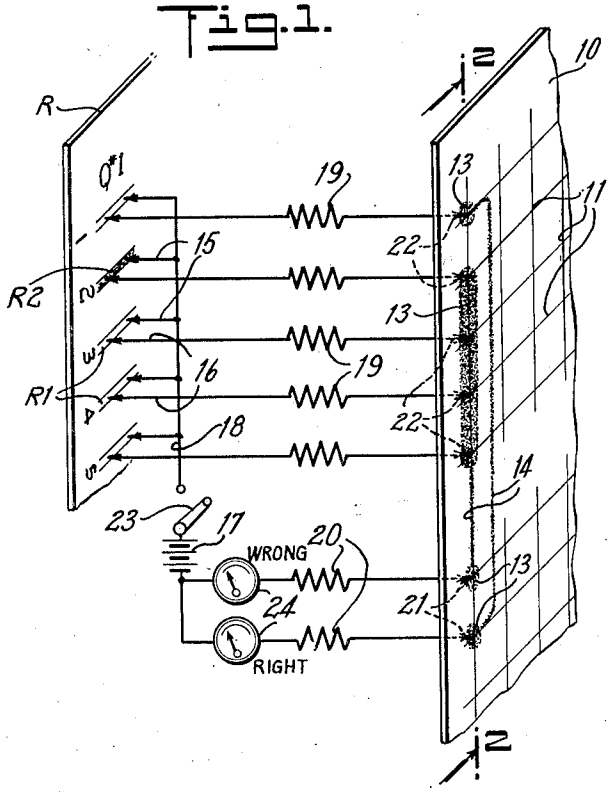


Fig. 2.

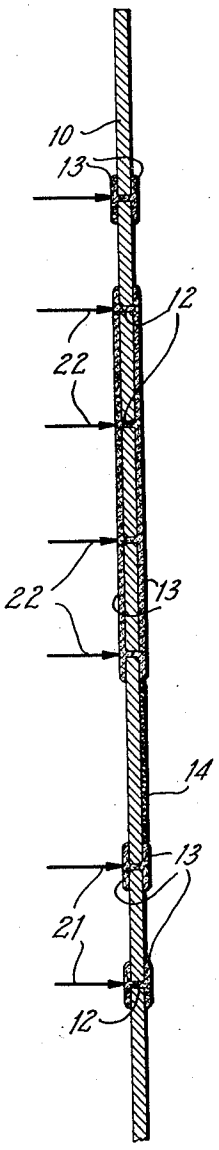
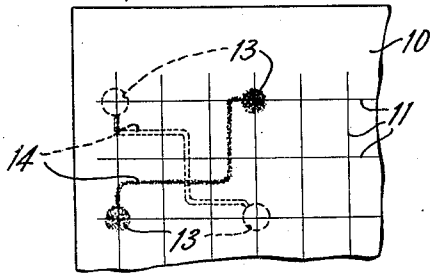


Fig. 3.



INVENTOR
Derk J. Oldenboom
BY
W. M. Malone
ATTORNEY

Patented July 4, 1944 2,353,061

UNITED STATES PATENT OFFICE

2,353,061

CIRCUIT CONNECTING DEVICE

Derk J. Oldenboom, Binghamton, N. Y., assignor to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application October 29, 1940, Serial No. 363,386

4 Claims. (Cl. 173—328)

This invention relates to a circuit connecting device which is simple in construction and consists of a sheet of card stock, across and through which current is conducted by means of paths formed of colloidal graphite to variously connect terminals of circuit connections.

In the copending application of Reynold B. Johnson, Serial No. 214,922, filed June 21, 1938, and issued March 10, 1942, as Patent No. 2,275,590, there is disclosed a record controlled machine in which the circuit connecting device of the present application finds especial utility. This machine is known commercially as the "International test scoring machine."

So-called plugboard panels are common in the electric accounting machine art where the plugboard provides a means variously interconnecting a multiplicity of circuits to condition the machines for the performance of different accounting operations. Such plugboards generally comprise a great many spaced jacks embedded in a panel of insulating material, and the opposite ends of plug wires are inserted in the jacks to effect electrical interconnection.

In place of such devices it is proposed to employ a sheet of card stock of the approximate thickness of an ordinary playing card. This sheet may be marked to identify variously located contact positions. At such positions the sheet is minutely perforated and the area surrounding such perforation on both sides of the sheet is covered with electrically conductive material in the form of an ink which penetrates through the perforation, so that the areas on both sides at a perforated position are electrically connected. By drawing a line on one surface of the sheet with the same conductive ink so that the line joins two of the areas, a continuous current path is provided from the area on one side, through the sheet to the opposite area, thence along the conductive line to another area and back through the sheet to the first side thereof.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawing, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawing:

Fig. 1 is a diagrammatic showing of a simple circuit arrangement to show the manner in which the connecting sheet is utilized to effect interconnection of the circuits.

Fig. 2 is an enlarged section taken on lines 2—2 of Fig. 1.

Fig. 3 is a detail showing the manner of effecting crossed connections.

The sheet 10 is of the thickness of a playing or record card and may be provided with cross lines 11 whose intersections constitute connecting positions which are coincident with the location of the terminals of wires which it is desired to interconnect in various arrangements.

At these connecting positions small perforations or punctures 12, such as may be made by a sharp knife or pointed instrument, are made, and within a prescribed area surrounding the position on both sides of the sheet colloidal graphite 13 which has been diluted with a wetting agent is applied by spraying or brushing. Preferably, the area is first masked to confine the application of the conductive agent within the desired limits. The application may also be made by printing processes if desired.

When applied in any of these manners, the graphite penetrates into the opening or puncture 12 to form a bond between the two opposite applications of graphite. From one of these areas a line 14 of the same colloidal graphite is drawn on the surface of the sheet to another area by means of a pen or stylus, thus effecting an electrical connection between the two selected areas.

Such line may be drawn to connect several areas as indicated in Fig. 1 with the limitation that the lines are not to cross one another. Where it is necessary in a particular case that lines cross, the conductive lines may be made on the opposite side of the sheet as shown in Fig. 3 where the dotted line indicates a connecting line 14 on the back. It may be noted that where the line 14 is on the same side of the sheet as the terminals, the ink need not penetrate through the sheet so that both the areas and line are on the same side.

Fig. 1 diagrammatically illustrates the utility of the invention. In this figure, R represents an examination sheet which is provided with columns of marking positions, one of which is shown. Each response designating or marking position R1 is delineated by a pair of parallel lines, between which an examinee is to draw a heavy black line R2 with a pencil or pen, coextensive with the parallel lines. Thus, for example, the five areas R1 represent five possible answers to question 1, and the mark R2 in the "2" position represents the examinee's choice of this possibility as the right answer.

When the examination sheet R is placed in the machine of said copending application, sensing

pins 15 and 16 engage the marking positions and, where a mark is found, the related pins 15 and 16 are electrically connected through the mark. Pins 15 are connected together and to a battery 17 by a wire 18, while each pin 16 is connected to related resistors 19 of 2 megohms each. The opposite side of battery 17 is connected to a pair of parallel ammeters 24 which through resistors 20 connect to terminals 21. Resistors 19 connect to terminals 22.

If now the sheet 10 is placed against the terminals as shown and a switch 23 is closed, a circuit will be traceable from battery 17, switch 23, wire 18, pin 15 in the "2" position, mark R2, pin 16, resistor 19 to terminal 22 (second from the top), conductive areas 12 through the sheet 10, conductive line 14 to the upper of the lower two areas 13, back through sheet 10 to the opposite area 13, terminal 21, resistor 20, the "Wrong" meter 24 and back to battery 17. The deflection of the meter needle indicates that the examinee's response is wrong. It can be readily seen that, if mark R2 had been made in the "1" position area R1, the circuit would be directed through the "Right" meter 24 to indicate a correct answer.

A particular feature of the invention resides in the so-called "self-seating" capability of the sheet 10. The sheet 10 being of flexible card stock, the inked areas will securely contact all of a great number of pins 22 allowing slight deviations in the pin lengths, which deviations could not be permitted in former rigid panels without the use of adjustably seated plug jacks.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. A circuit connecting device comprising a flexible sheet having a plurality of index point positions on both sides, with the positions on both sides coinciding, said sheet being punctured at its index point positions and covered with conductive ink over a delimited area surrounding one or more positions, said ink penetrating the punctures to conductively connect the areas of conductive ink on the opposite sides.

2. A circuit connecting device comprising a sheet of flexible insulating material having a plurality of index point positions, said sheet being punctured at all said positions, a delimited area on each side of the sheet surrounding a single punctured position, being covered with colloidal graphite completely penetrating the puncture to form an electrical connection between the areas on both sides of the sheet.

3. A card for controlling the operation of a statistical machine, said card having columns and rows of index point positions surrounding each of which positions there is a deposit of conductive ink on both sides of the card, and means comprising conductive ink for causing any pair of opposite deposits of ink to be electrically connected directly through a puncture in the card at the related position whereby electric current may pass through the card at such position to control the machine in accordance with the position in which such connection is made.

4. A card for controlling the operation of a statistical machine, said card having columns and rows of index point positions surrounding each of which positions there is a deposit of conductive ink on both sides of the card, a puncture smaller in area than the ink deposits being made in the card at any index point position, and conductive ink in said puncture to electrically connect the opposed deposits whereby electric current may pass through the card at such position to control the machine in accordance with the position in which such connection is made.

DERK J. OLDENBOOM.