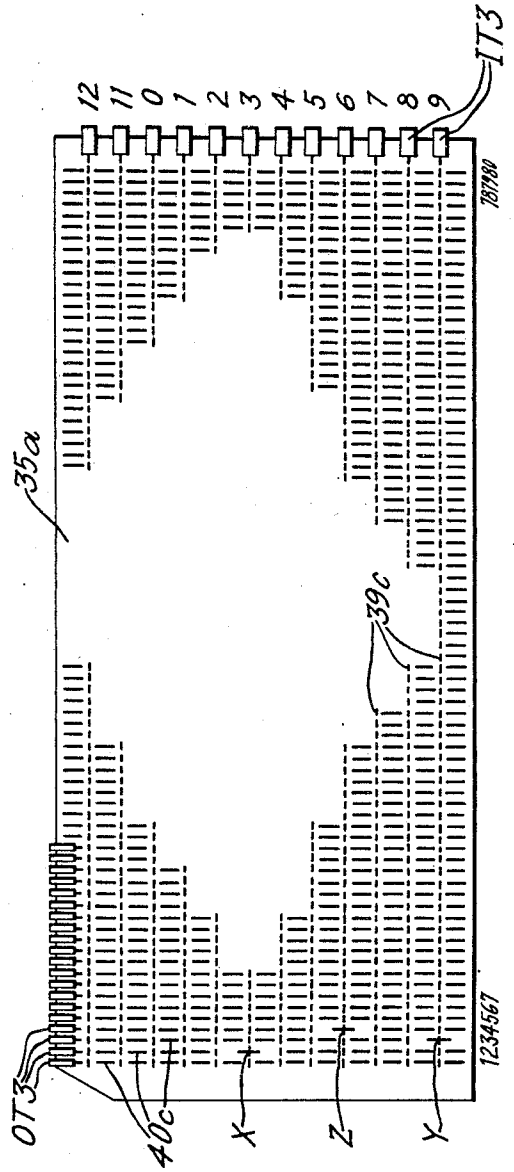
Sept. 7, 1948. J. W. ARMBRUSTER 2,448,761

CIRCUIT BEARING ELEMENT

Filed Oct. 23, 1947

Fig. 1.



INVENTOR

John W Armbruster

Patented Sept. 7, 1948

2,448,761

UNITED STATES PATENT OFFICE

2,448,761

CIRCUIT BEARING ELEMENT

John W. Armbruster, East Rockaway, N. Y., assignor to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application October 23, 1947, Serial No. 781,577

5 Claims. (Cl. 235—61.12)

1

This application is a continuation-in-part of my Patent 2,353,001, filed December 30, 1937 and issued on July 4, 1944, there being continuity through my application Serial No. 521,232, filed on February 5, 1944.

This invention relates to an improved form of record for controlling an accounting machine wherein the records may remain undisturbed in a file while being analyzed to control devices for accumulating and printing the data represented thereon. The novel construction of the record as a machine control element is also a feature of this invention, because it is by means of selectively connected conducting lines in the record that a series of records may be sensed successively, even when filed close together in a compartment or file drawer. Heretofore, in order that accounting information could be gathered from record cards, it was necessary to remove such cards from a file, place them in an accounting machine, feed and sense them one by one, and then return them to the file.

Another object of the invention is the provision of a machine control element in the form of a sheet of insulation material with a network of electric conducting lines therein with ten of said lines representing the ten digits and other of the lines selectively connected thereto to form a readout device.

An object of the invention is the production of a machine control element of woven material with an interwoven network of conducting threads, certain of said threads acting as a readin means for carrying differentially timed digit representing impulses, and others of said threads selectively woven into contact with various readin threads and in turn acting as a readout means for directing data representing impulses to machine controls.

Another object of the invention is the provision of woven data readout connections on a machine control element, said connections extending to the edges of said element so that even when a series of such elements are stacked together, the data on a confined element may be sensed by electrically analyzing the terminals of said connections at the edge of the element.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, 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 the single view shows a sheet of insulation carrying two sets of grid conducting lines which are woven into contact at certain intersections or index points to represent fixed circuit arrangements and fixed data.

2

The invention is disclosed in the form of devices associated with tabulating machines, such as those disclosed in the Bryce Patent No. 1,902,013 and Daly Patent No. 1,762,145. Machines of this kind are ordinarily operated by feeding perforated records through the machine. The perforations in the record are sensed as the record moves and the location of the perforation on the record controls the timing of impulses for regulating the various accumulating, printing and group control devices. It is characteristic of such machines that a perforation representing the digit 9 is situated near the bottom of the record so that it is sensed early in the operating cycle and is thereby distinguished from a perforation representing the digit 2 which is sensed later in the operating cycle. Thus, it is evident that the functioning of the machine depends upon a movement of the record to control the timing of impulses initiated by the appearance of perforations in the record.

The devices of the present invention differ from the ordinary tabulator control by providing electrical devices adapted to function while at rest and providing conducting wires or lines arranged to contact in such a fashion that differentially timed impulses are directed through connections established at the index points.

According to the present invention, a pair of separate intersecting woven grids are brought into contact at selected points of intersection of the lines or wires of the grids. The woven construction provides extensions bending in and out and at certain intersections permitted to come into contact and form selective paths for the impulses which are timed to be representative of the data. A grid frame of insulation sheeting **35***a* carries a set of horizontal lines **39***c* or wires and a set of vertical lines **40***c*. With two such sets of lines brought together, there are a plurality of intersections, each having a location like that of an index point of a tabulating record. The horizontal lines may be formed with eighty warp extensions to project through the sheet at regular intervals and with equal spacing. The vertical lines are formed with twelve woof extensions spaced evenly and coinciding in position with the usual twelve columnar positions of index points. It is only at certain of the intersections that the weaving is such as to bring a horizontal line into contact with a crossing vertical line and at such points a circuit connection

is made representative of a desired path or a data value. At most crossings, the intersecting lines are separated by the thickness of the sheet and thus insulated electrically.

The impulses directed through the grids are received at input terminals IT3 and pass through the horizontal lines 39c to the contacting vertical lines 40c and up to output terminals OT3 affixed to the upper edge of the grid sheet or body 35a. Each of the twelve horizontal lines 39c is connected to one of the terminals IT3 and insulated from all others by the composition of the sheet. In a similar manner, each of the eighty vertical lines 40c is connected to one of the terminals OT3 and insulated from all others.

As explained in Patent No. 2,353,001, of which this is a continuation-in-part, an impulse emitter is provided and driven in synchronism with the tabulator. The control impulses from the emitter are directed through the horizontal lines 39c at differential times. The bottom line 39c receives the first impulse which coincides in time with the usual "9" impulse of the ordinary tabulator cycle. A second impulse is directed into the horizontal line 39c second from the bottom, and the other impulses follow in order up the grid sheet. Should one of the vertical wires 40c be so woven at the "9" position as to extend into contact with the lowest horizontal wire 39c, it is apparent that the "9" impulse will be received and transmitted through the upper terminal OT3. In a similar fashion any other differentially timed impulse will be carried along a related horizontal line, picked out by the contacting vertical line and carried up to the output terminal OT3, at which point it passes through a contacting connection and is carried into the tabulator.

The terminals IT3 and OT3 are metallic clips which are clamped over the ends of the conducting wires and on the edge of the grid element. A good electrical connection is thus established and made available outside the confines of the grid elements when they are stacked together as in a file.

It is understood that when operating with the previously described woven grid construction, pressure may be applied on the faces of the stack to insure contact between warp and woof line projections. When such grid bearing record constructions are of thin flexible material such as rubber, asphalt or other plastic vegetable or mineral material, the application of pressure will form the grid sheets, grid wires and spacers into an interlaced unit, as a wire supporting structure.

The drawing shows a form of machine control element devised to take the place of the perforated record and to operate without requiring the provision of separate grids, the record itself containing all the conducting wires or lines forming the grid connections. The body 35a of this element may be made of woven cotton or glass threads, or it may be composed of other insulation materials such as paper or "Bakelite" which are perforated at intervals to simulate woven material. Through this element the set or series of twelve horizontal conducting lines 39c are threaded or deposited in such a fashion that they appear at intervals, first on one side of the record and then on the other side. Such threading can be done by hand either after weaving the body of the element or along with such weaving. For more rapid operation, selective pattern weaving is performed automatically in Jacquard looms. Other lines 40c are woven in a vertical direction in such a manner that at most of the points of intersection of the horizontal lines therewith, the two different lines are separated by the material 35a. However, contact is established at certain select points of intersection X, Y and Z in order that the contacting conducting lines may form a readout means for emitting a plurality of differentially timed impulses.

On the element shown, it is noted that the weaving of the lines differs from the usual arrangement in three places, at points X, Y and Z. At these points the horizontal lines come into contact with the vertical lines which are there woven out on the same side of the material 35a as the horizontal lines and directly in contact therewith, the result being that when a regular series of timed impulses are received at the terminals IT3 attached to the end of the horizontal lines 39c, three of such impulses are selected to be emitted through the upper terminals OT3. The intersection X is made at a point in the "3" impulse horizontal receiving line and connected to the highest order vertical emitting line. The other two points of connection, Y and Z, are arranged to read out "9" and "6" impulses, respectively. Therefore, the record element shown is constructed with a series of intersecting lines or wires, said lines contacting to represent the number 396.

When records such as that shown are stacked together in the file, they will be separated by spacers such as pieces of paper or "Bakelite" in order that the conducting lines of the adjacent records may be prevented from establishing contact.

As explained hereinbefore, an impulse emitter is provided and driven in synchronism with the operation of the tabulating machine. The control impulses from the emitter are directed through the horizontal lines 39c at differential times. The bottom line 39c receives the first impulse which coincides in time with the usual "9" impulse of the ordinary tabulator cycle and then the other wires are successively energized. Wherever one of the vertical lines 40c protrudes into contact with the lowest horizontal wire 39c, it is apparent that the "9" impulse will be received and transmitted through to the upper terminals OT3. In a similar fashion any other differentially timed impulse will be carried along a related horizontal line, picked out by the contacting vertical line and carried up to the output terminal OT3, at which point it passes through a contacting connection and is carried into the adding or printing control devices of the tabulator.

When the tabulator is connected for control by the grids of the present invention, the usual upper and lower brushes are not used and the plug wiring therefrom may be removed from the sockets connected to the adding, printing and group control magnets. The card feeding unit is not used, but it may be allowed to operate without placing any records in the magazine. The usual upper and lower card lever contacts ordinarily close when cards are fed through the regular sensing unit, but in the present instance they may be shunted by closing switches to provide shunt circuits around the contacts.

The impulse emitter already mentioned is provided for initiating in each cycle a set of twelve differentially timed impulses corresponding with the impulses usually sensed when reading the perforations of a moving record card. This emitter is connected to be driven by the mechanism

in the tabulator. Although the grid assemblies remain stationary in a file, each card is analyzed as though in motion by the successive timing of the impulses. The different records in the grids are sensed in succession by movement of a contacting structure placed in the file and provided with an escapement mechanism for controlling movement of the contactors over the grid terminals, so that one record after another is brought into association with the sensing control.

In addition to the previously mentioned parent Patent 2,353,001 claiming devices for sensing and reading out data representing impulses from a file of grid line elements, there are three other copending patent applications related to this case. Patent 2,353,003 contains claims for record sensing elements having conducting lines or wires deposited thereon. Application Serial No. 521,232, filed on February 5, 1944, sets forth claims for record sensing elements having separate sets of woven vertical and horizontal grid lines. Application Serial No. 781,576, filed on October 23, 1947, asserts claims for record sensing elements, each of the grid elements bearing both sets of woven vertical and horizontal grid lines.

While there have 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. As an article of manufacture, a thin rectangular sheet of insulation material, said sheet having woven therein in a vertical direction a plurality of regularly spaced conducting lines, said lines having regularly spaced exposed woof portions along the length of the lines, said sheet also having woven therein in a horizontal direction a plurality of regularly spaced conducting lines, said lines having regularly spaced exposed warp portions along the length of the lines, said warp and woof portions of the lines of both sets crossing and separated by said sheet at all except predetermined crossings where they are brought into contact for conduction of electrical impulses therethrough, with ends of said sets of lines extending on said sheet beyond said crossings and forming terminals, whereby impulses can enter into the horizontal set of lines, selectively pass through the predetermined crossings and emerge from the other set of lines.

2. As an article of manufacture, a thin rectangular sheet of insulation material, said sheet bearing two separate woven sets of conducting lines, said sets arranged at right angles to each other, one of said sets having lines allocated to different data, both sets of said lines extending to the edges of said sheet to provide terminals for external contacts, each of said lines also having outwardly spaced woven portions along the length of the line at intervals and in number corresponding with the spacing and number, respectively, of the lines of the set other than the set of which the line is a member, said outwardly

woven portions at most intersections between lines of different sets being brought out on opposite faces of said sheet and insulated thereby, but at selected intersections, said portions being brought out on the same face and into contact to form a circuit path.

3. A circuit connecting device comprising a sheet bearing a woven set of spaced conducting lines aligned in one direction and a separate woven set of spaced conducting lines arranged at an angle with the first mentioned set, said sheet also having a plurality of index point positions, there being one at each crossing of said lines, said lines being formed with crossing and facing warp and woof projections at all line crossings wherein weaving is varied at certain of said crossings to bring the warp and woof projections into contact as distinguished from the ordinary separated weaving of lines at all other crossings, with ends of said sets of lines exposed on sheet portions free of said index point positions, whereby terminals are provided for external contacts.

4. A flat data representing device comprising a sheet of insulation material, said sheet provided over a data representing area with a woven set of spaced horizontal conducting wires representing data value and a woven set of spaced vertical conducting wires representing ordinal position, said wires having warp and woof portions being either together or separated from each other and said sets arranged in contiguous regulation and contacting electrically at certain predetermined intersecting points where the wires have said portions which are together, with terminals of said sets of wires exposed at the edge of said sheet, whereby data representing impulses can enter into the horizontal set of wires, selectively pass through the contacting points and emerge from the other set of wires, said impulses representing the data of the sheet.

5. A circuit connecting device comprising a sheet of insulation, a set of 80 ordinal conductors woven into said sheet and aligned in a vertical direction, a separate set of number representing conductors also woven into said sheet and aligned in a horizontal direction, said insulation sheet having an index point position at each of the crossings between vertical and horizontal conductors, said conductors being formed with warp and woof projections at said crossings, there being contact between certain warp and woof projections of crossing conductors at certain of said points to conductively connect selected ordinal representing vertical conductors to selected horizontal numeral representing conductors, said sets of conductors extending beyond the sheet area containing said crossings, whereby terminals are provided for external contacts.

JOHN W. ARMBRUSTER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
Re. 20,224	Van Billiard	Dec. 29, 1936
1,981,987	Bryce	Nov. 27, 1934
2,014,432	Gerhold	Sept. 17, 1935
2,353,003	Armbruster	July 4, 1944