Nov. 9, 1937. L. E. LENTZ 2,098,345

CONTROL CARD

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*Fig.1.*

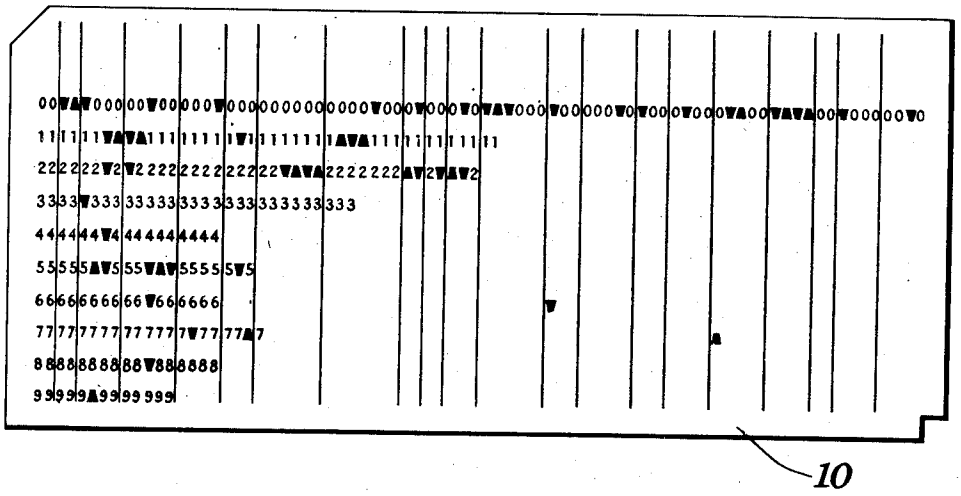
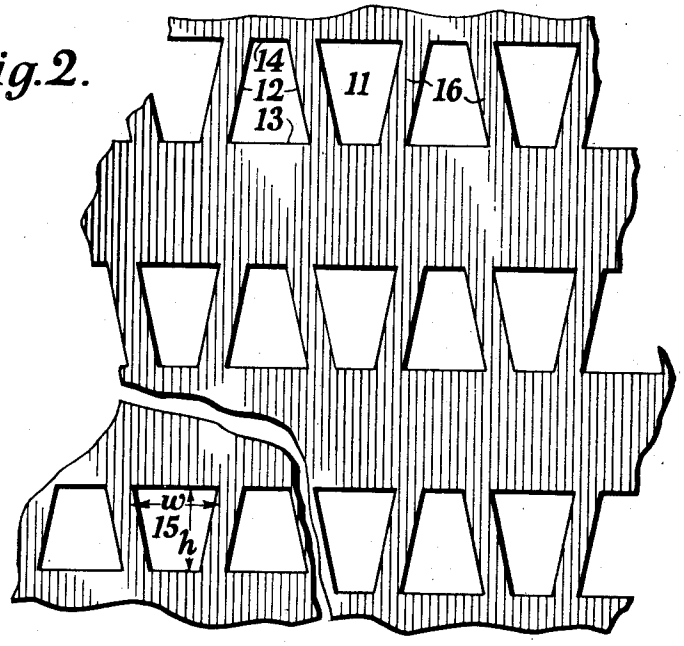



*Fig.2.*




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## CONTROL CARD

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8 Claims. (Cl. 235—61.12)

The invention relates to a new and improved form of control material in sheet form having perforations utilized to predetermine the extent and manner of machine operations.

The invention is illustrated and described in this application as embodied in a card of the type employed to control the operations of tabulating and similar machines. It is to be understood, however, that the invention is not limited in its application to cards but that it may be embodied with advantage in tapes and other perforated sheets and sheet material.

Control cards per se are well known in the art, one particular type being exemplified by the several patents to Hollerith; No. 395,781 dated Jan. 8, 1889; Reissue No. 12,523 dated Aug. 28, 1906; No. 945,236 dated Jan. 4, 1910, and No. 1,109,841 dated Sept. 8, 1914.

Another character of such card is illustrated in the following patents: Soulage No. 941,892 dated Nov. 30, 1909; Waters No. 1,128,923 dated Feb. 16, 1915; Roberts No. 1,174,286 dated March 7, 1916; Hathaway No. 1,444,505 dated Feb. 6, 1923; Lake No. 1,772,492 dated Aug. 12, 1930, and Thompson et al. No. 1,873,510 dated Aug. 23, 1932.

The first mentioned group of patents disclose control or tabulating cards employing circular apertures, whereas the second group depend upon the use of square, rectangular, or oblong apertures.

Preliminary to a description of the present invention, it will be well to point out that the differentially positioned apertures, or, as they are sometimes referred to, the statistical perforations at the index positions of such cards, govern operation of either mechanical or electrical analyzing means, which in turn are adapted to predetermine the character and extent of machine operations. Thus in tabulating machines the analyzing means operates, among other ways, to predetermine the extent to which the wheels of one or a plurality of totalizers will be rotated for the purposes of storing and/or printing quantitative data, as represented by the relative positions of the respective index points with respect to normally disposed reference lines.

It will be understood that the distance of a given perforation from, say, the vertical reference line might determine the particular totalizer wheel to be selected for actuation, whereas the height of the same aperture above a horizontal reference line might predetermine the extent of movement to be imparted to the selected wheel.

In machines employing mechanical analyzing means, the card is fed into juxtaposition to a nest of pins, whereupon such pins as are aligned with apertures in the card are projected therethrough for abutting coaction with mechanisms individually articulated with, or operable to condition, the individual totalizer wheels. In such machines it is desirable that the maximum overall width of the pins be such as to permit the grouping of a maximum number of apertures in a given horizontal length of card, or, otherwise stated, to control a maximum number of wheels or machine operations through the medium of a card of minimum length.

It will at once be apparent that considerations of strength and rigidity limit the amount to which the cross sectional area of the analyzing pins can be reduced, and that the configuration of the apertures formed in the card similarly serves to limit the total number of apertures which can be placed in a continuous horizontal line without seriously impairing the strength and usefulness of the card.

In machines of the electrical type the perforated control cards are fed under one or a plurality of contact brushes which are caused to drop into the respective apertures to engage an underlying conductor and thus establish electrical circuits controlling mechanism adapted to rotate or condition the respective totalizer wheels for operation. In such machines a primary desideratum is the provision of a control card in which the apertures are of maximum length in the direction of the vertical axis of the card so as to provide a maximum duration of contact between the brushes and underlying conducting surfaces in each position corresponding to an aperture.

It is therefore a primary object of the present invention to provide a control card having a new and improved form of aperture and adapted for use in either mechanical or electrical machines of the class described.

It is a further object of the invention to provide a form of statistical aperture in a control card, such that a maximum number of apertures may be formed in horizontal rows of given length without impairing the strength of the card.

Yet another object of the invention is the provision of a card of the character described, in which the configuration of the apertures is such as to permit the use of analyzing pins of maximum rigidity.

Other objects and advantages of the present invention will become apparent in connection with the following detailed description of a pre-

ferred form and an alternate form of the invention.

In the accompanying drawing,

Figure 1 represents a plan view of a control card having statistical perforations formed in accordance with the present invention.

Figure 2 is an enlarged fragmentary view of a card embodying the invention and showing perforations of the preferred form and of an alternate form respectively.

Referring to Figure 1, a tabulating card is disclosed at 10. The card is preferably formed with a plurality of vertical columns, and horizontal rows, of index positions at which apertures are adapted to be formed, it being understood that the spacing of the respective columns corresponds with the spacing of the card engaging elements of the individual totalizer wheel controlling means, and that the spacing of horizontal rows is correlated to the differential extents of movement to be communicated to the respective wheels.

With a view to the accomplishment of the before mentioned objects, the card 10 is perforated in the columns and rows previously identified with polygonal apertures 11, as shown particularly in Figure 2. In the present embodiment of the invention the polygonal apertures are given the form of isosceles trapezoids; that is, four sided polygons having two parallel sides, and one pair of non-parallel sides, the non-parallel sides defining equal angles respectively with the parallel sides.

In the main portion of Figure 2, the non-parallel sides are indicated at 12, the major of the parallel sides at 13 and the minor of the parallel sides at 14.

Preferably the vertical dimension of the trapezoid is greater than its extreme horizontal dimension, although it will be understood that an aperture of similar configuration, in which the vertical dimension would be equal to, or less than, the extreme horizontal dimension, is within the contemplation of the invention. In the lower left hand portion of Figure 2, for example, the dimension "w" may be equal to, or greater than, the dimension "h" in the aperture 15.

The apertures are formed in the card 10 with the major of the parallel sides 13, defining the base of each of the apertures in the alternate positions in each horizontal row, and the minor side 14, defining the base of each of the other apertures. Furthermore, the apertures in alternate columns are arranged so that the major side 13 defines the base of every aperture in one column, the minor side 14, defining the base of every aperture in the next adjacent column.

The non-parallel sides of adjacent apertures in each row are spaced apart to simulate truss-like webs 16, connecting the material of the card above, and below, each row of apertures.

It will be observed from the drawing that punching of a continuous row of apertures of the type disclosed, results in the formation of what corresponds to a triangulated truss in the card, the webs 16 functioning to prevent the formation of a line of maximum weakness along which the card might tend to bend, or tear, as is the case when a maximum number of circular apertures are formed. In addition, it will be obvious that the triangulated apertures do not seriously detract from the strength of the card because of the tendency of the webs 16 to resist shearing of the card along the row of apertures, the alternate webs tending to act in tension regardless of the direction of the shearing stress to which the card is subjected. Thus with the maximum number of apertures adapted to be formed in a horizontal row, the resulting structure of the card is appreciably stronger than in the case when circular or rectangular apertures are employed.

It will additionally be obvious that the configuration of the aperture is such that its vertical dimension, or in other words its length in the direction of movement of the card, is sufficient to allow ample time for brushes such as are used in electrical tabulating machines to drop into the aperture and engage an underlying electric circuit forming element.

Furthermore, the contour of the aperture is such as will permit the use of analyzing pins of maximum strength with minimum cross sectional area in the event that the card is to be employed in machines of the type which utilize mechanical analyzing or sensing means. In this connection it will be noted that the section modulus of the preferred form and that of the alternative form of the apertures is such as to insure rigidity in a pin of corresponding cross section, regardless of the direction of the stress to which it is subjected.

From the foregoing description it will be obvious that I have provided a configuration for apertures in control cards which lends itself to use in connection with either mechanical or electrical machines, and is such that a maximum number of apertures may be formed in a card of minimum size, without seriously impairing the strength or usefulness of the card.

It is to be understood that the invention is not limited to perforated sheet material having apertures of the particular form shown in the drawing of this application but that the invention may be embodied in such material having apertures of other forms within the scope of the claims.

I claim as my invention,

1. A tabulating sheet having trapezoidal apertures arranged in vertical columns and horizontal rows and each having two opposite non-parallel sides, the apertures in adjacent columns being inverted.

2. A tabulating sheet punched to define trapezoidal apertures arranged in spaced vertical columns with the major and minor parallel sides respectively of the trapezoids defining the bases of apertures in adjacent columns.

3. A tabulating sheet having trapezoidal apertures arranged in vertical columns and horizontal rows with the major parallel sides of the trapezoidal apertures defining the bases of the apertures in alternate columns, and the minor parallel sides of the trapezoids defining the bases of the apertures in other columns alternating with said first columns.

4. A control sheet having statistical perforations arranged in vertical columns and horizontal rows, each perforation including a pair of converging sides, the sides of the perforations in alternate columns converging toward points above the row identified with any particular perforation, the sides of the perforations in other columns converging toward points below the row identified with any particular perforation in said other columns.

5. A tabulating sheet having trapezoidal apertures arranged in horizontal rows with the respective major and minor of the parallel sides of adjacent trapezoidal apertures defining seg-

ments of a line extending horizontally of the card.

6. A tabulating sheet perforated to define spaced polygonal apertures arranged in horizontal rows, each of said apertures being defined by a pair of spaced parallel horizontally extending edges and a pair of converging edges connecting said parallel edges, the adjacent edges of adjacent apertures extending substantially parallel one to the other.

7. A control device of sheet material having locations for perforations in vertical columns and horizontal rows and having vertically tapering perforations formed at certain of said locations and relatively inverted in adjacent columns.

8. A control sheet having locations for perforations in vertical columns and horizontal rows and having vertically tapering perforations formed in said sheet at certain of said locations, the perforations in alternate locations in a horizontal row being inverted with relation to perforations in other locations in said row.

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