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K. A. KNUTSEN
PERFORATED CARDS IN CONNECTION WITH TABULATING MACHINES
Filed July 5, 1939

Serial No.
282,870
3 Sheets-Sheet 1

Fig. 1

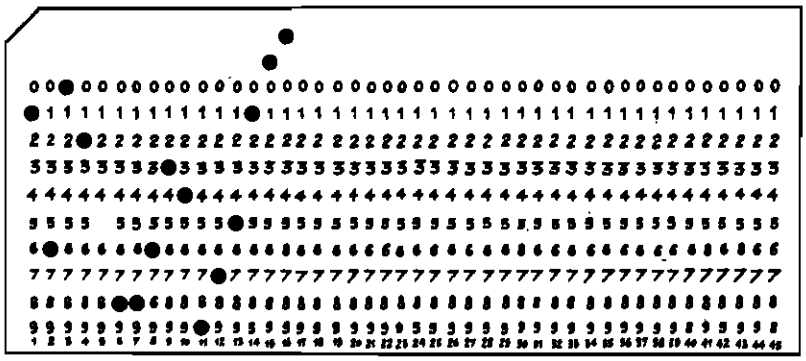

Fig. 2

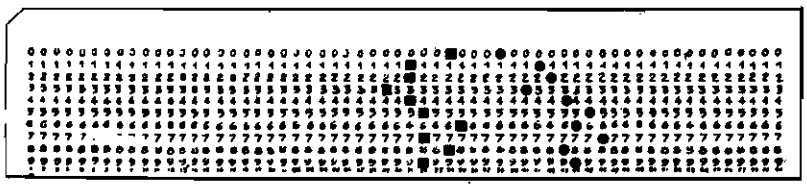

Fig. 3

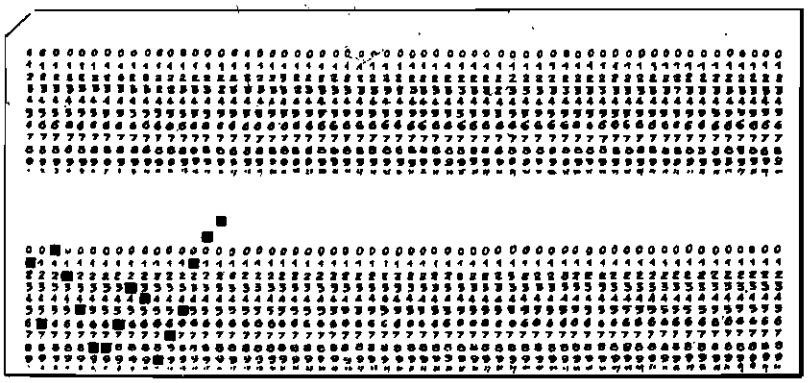

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Fig. 4

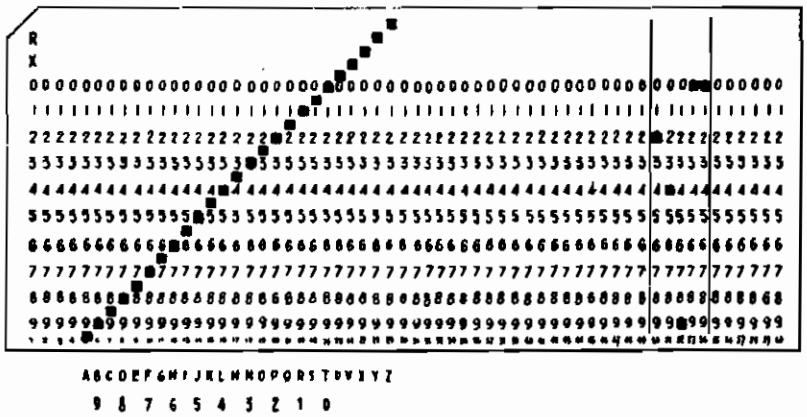

Fig. 5

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Fig. 6

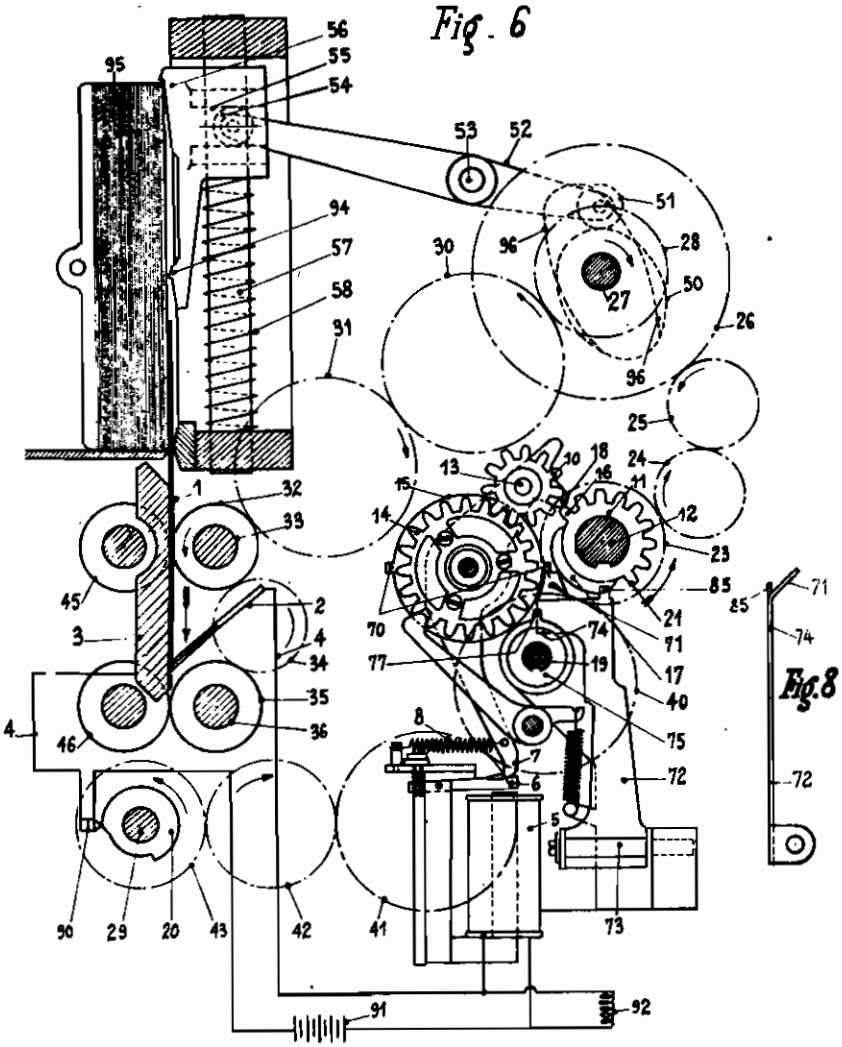
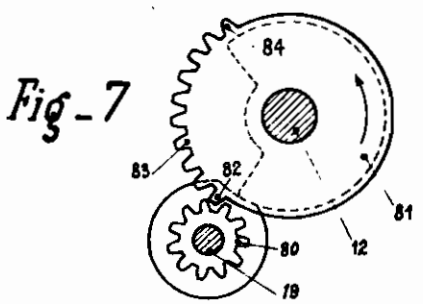


Fig. 8

Fig. 7



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ALIEN PROPERTY CUSTODIAN

PERFORATED CARDS IN CONNECTION WITH TABULATING MACHINES

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The present invention relates to perforated cards in connection with tabulating machines.

Such control cards are well known in the art. They are divided in vertical columns and horizontal lines, each vertical column being provided with 10 index point positions, representing the numerals from 9 to 0. A numerical value is indicated by a perforation in the corresponding index position.

The invention relates especially to perforated cards in connection with tabulating machines, in which the cards are fed under one or a plurality of contact members, preferably brushes, which, in making contact through the perforations of the card establish electrical circuit impulses. By their timed relation with respect to the cycle of the machine, said impulses control the action of the totalizers, or the action of the printing device. The cards are fed under the brush in the direction of the vertical columns of the card, and the timing of each electrical circuit impulse is determined by the location of the corresponding perforation in a vertical column of the card.

It has been the practice to use circular perforations and cards of a determined size. In order to obtain a greater number of columns without increasing the width of the cards, it is possible to reduce the width of each column, which involves a reduction of the width of the perforations. The number of vertical columns can thus be made as high as 60 and even 80. However such an increase of the number of columns on a card of given width is limited. For a card such as that utilized in connection with a Bull machine, the increase of the number of columns up to 80 gives perforations of a very reduced width and diameter, which involves some difficulties in the handling and the reading of the card.

An object of the present invention is to provide a card of the type described having a greater number of columns than a card of the usual type of equal width and with which the drawbacks above mentioned are entirely avoided.

To this effect, according to my invention, I reduce the height of the perforations and divide the card horizontally into two or more parts each of which has the same characteristics and properties as the existing cards of the usual type, the interval between perforations, measured in the vertical direction, being however smaller than in the existing cards of the usual type.

As a matter of fact there exists cards, intended in particular for statistical machines of the mechanical type, that are divided horizontally into two parts. But the number of perforations that can be made in each vertical column of a given horizontal portion of the card is limited to 5 or 6, and anyway to a number smaller than 10. In these cards, a numerical value is indicated by a combination of two or more index point positions, whereby only four index positions are necessary in a vertical column to represent the numerical values from 0 to 9. The punching of combined perforations is however inconvenient and requires generally a special keyboard. Further the verifying and reading of combined perforations involves more difficulties than the verifying and the reading of single positional perforations, and errors are more frequent. In tabulating machines of the electrical type, the use of cards with combined numerical perforations necessitates a special device for transferring the combined electrical impulses into a single impulse, because the totalizers generally are adapted to be actuated by a single electrical impulse for each value to be introduced on a totalizer element. Another inconvenience with regard to said known cards is that the values indicated on two different horizontal portions cannot be introduced into one same totalizer, but each horizontal portion requires each a totalizer. On the contrary, with the arrangement according to the present invention, the columns of each horizontal portion of the card include at least ten places each capable of receiving a perforation exactly as in the case of an ordinary card for an electrical machine.

The desired reduction of the height of the perforations can be obtained by utilizing a circular perforation of small diameter. However, with electrical machines, circular perforations do not give the same safety of contact as a square perforation. For this reason, the perforations utilized according to the present invention are of square or substantially square shape. It has been earlier proposed to use small rectangular perforations in a card of normal size, but the advantage which these small square perforations could carry along has not been exploited. The centre of these small perforations remained in the same place as the known elongated rectangular perforations. The only effect was to increase the material between two vertical adjacent perforations, without increasing the capacity of the card. Further, it was thought that the speed of the machine had to be reduced in order to assure a sufficiently long contact when a perforation passed the analyzing device. These known perforations were thus without utility with relation to the operation of the machine, and there was practically no valuable reason for using them,

The lower speed of the machine however will increase the space of time between impulses established by adjacent perforations in a vertical column of the card, and thus extend the cycle of the totalizers. I have observed that in consequence it is therefore possible and it is an object of the present invention to reduce the vertical distance between adjacent index point positions in a vertical column of the card when said small square perforations are employed, and modify the connection between the card feeding means and the totalizer operating means, in a corresponding way such that the space of time between consecutive index point impulses may be about the same as for a usual card, with usual performed. The cycle of the totalizers may then be perforated in about the same space of time as usual, but the height of a vertical column comprising ten index point positions will be reduced, the capacity of the card in relation to the card surface will be increased, and more data may be placed on a card which has substantially the usual size, whereby the card is convenient to handle and to read and may be used in the existing tabulating machines with some changes in said machines.

An object of the invention is a card divided in two or more horizontal portions, each of which has ten index positions, in combination with a tabulating machine in which the card feeding means is connected to the totalizer operating means in such a way that the totalizer is performing one cycle for each horizontal portion of the card that passes beneath the analyzing means.

According to the present invention, it is possible to assemble on a single card the data contained on two normal cards without increasing substantially the dimensions of the card and without employment of the plural positional numerical index points.

It is evident that in case such plural positional numerical index points should be desired, the capacity of the card according to the invention would be further increased.

Further objects and advantages of the invention will be seen from the following specification, as well as from the drawings which show a preferred embodiment of the invention:

Fig. 1 shows a usual card with circular perforations.

Fig. 2 shows a card of about half the height of a usual card with small square perforations and a reduced distance between adjacent perforations in a vertical column.

Fig. 3 shows a card of usual size divided in two horizontal portions with small square perforations and a reduced distance between adjacent perforations in a vertical column.

Fig. 4 shows a card of normal size with small square perforations and a reduced distance between adjacent perforations in a vertical column of the card, said perforations representing the different letters of the alphabet.

Fig. 5 shows a card combining the features of a card shown Fig. 3 with a card divided in two horizontal portions.

Fig. 6 shows schematically the card feeling device for a card according to Fig. 4, the card analyzing device, the totalizer and the mechanical and electrical connection between the totalizer and said devices.

Figs. 7 and 8 show details of the totalizer.

The square perforation gives a larger contact surface than the circular perforation of the same width, whereby more wires of the brush may make contact coincidently, and heating and destruction of the wires may be avoided. Also the handling and reading of a card with square perforations is easier than the handling and reading of a similar card with circular perforations.

The use of the small square perforations permits to divide a card of substantially normal height into two or more horizontal portions each of which has the same characteristics and properties as the existing cards of the usual type and at least ten index point positions in a vertical column of each portion.

When a card of the usual width is divided in two horizontal portions each with sixty vertical columns with ten index point position, and the substantially square perforation is employed as indicated on the Figs. 2 and 3, in which the width of the square perforation is about the two thirds of the distance between adjacent vertical columns and about the two thirds of the distance between centers of adjacent perforation in the same column, the contact surface of said square perforations will be about equal to the contact surface of the elongated perforation of the usual eighty column card not divided in horizontal portions. A card of substantially normal size, according to Fig. 3 could therefore be fed with approximately the same speed as a card with elongated perforations and would have the advantage of its greater capacity.

It is evident that a certain number of variants of cards may be possible, and that for a determined speed of the machine, a determined variant of card would be the most advantageous. But these variants according to the invention would have the same characteristics of a reduced total height of ten different indext point positions in a vertical column and a greater number of index point positions on a given surface of a card than possible until now.

As shown in Fig. 2 by reducing the height of the perforation made in a card and the distance between said perforations, measured in the vertical direction, it is possible to obtain a card the height of which is reduced to about one half of the height of an existing card of the ordinary type.

It is then possible to divide a card of normal size into two horizontal portions *a* and *b* each of which is similar to the arrangement of Fig. 2, thus finally obtaining a card such as shown in Fig. 3. With such a card, made of a size equal to that of an existing card of the ordinary type, or of a size very little different therefrom, there is obtained a number of vertical columns which is equal to twice that of an ordinary card. In another words, the capacity of the ordinary card is doubled.

I will now briefly explain, with reference to Fig. 6 how the values indicated by the perforations of a card of the type shown in Fig. 3 are transferred to the adding device of a tabulating machine of the kind, for instance, of the Bull machine.

The card Fig. 1 is driven in front of the brushes 2 that examine the columns. For each vertical column of the card there is a brush. When a perforation of the card comes under a brush the latter is brought into contact with the rear plate 3 and closes an electric circuit 4 which energizes electromagnet 5. The latter attracts the armature 6 and releases lever 7 which, under the action of the spring 8 pivots about the spindle 9. To the other end of lever 7 is fixed a pin 13 on which is mounted a toothed wheel 10 which, due

to the movement of lever 7, meshes with a mutilated wheel 11 keyed on shaft 12 which turns continuously in synchronism with the passing of the cards in front of the brushes.

Wheel 10 is always in mesh with the accumulator wheel 14 which is rigidly fixed to the drum 15 that carries the figures on the periphery thereof.

The card feed mechanism is coupled with the totalizer operating shaft 12 in such a manner that when the perforation numbered 9 in one of the horizontal sections of the card passes under the corresponding brush, and the electro-magnet is energized and the lever 7 released, wheel 10 will mesh with the first tooth 16 of the toothed wheel 11 as shown in Fig. 6. Wheel 11 has 9 teeth and therefore causes wheel 10 and consequently the accumulator wheel to turn through an angle corresponding to 9 teeth in the forward direction. If the column that is considered does not contain a perforation 9 but a perforation 8, the contact of the brush with the plate 8 only takes place a little later when the card has been brought into a position such that the perforation numbered 8 is located under the brush.

Assuming that shaft 12 turns in synchronism with the movement of the cards through the machine, wheel 11 has now rotated through an angle corresponding to one tooth in the direction of the arrow, and therefore when wheel 10 meshes with wheel 11 it meshes with the second tooth of said wheel 11 and the aecumulator wheel will be rotated eight teeth. If a column of the lower portion of the card is provided with a perforation 1, the electric contact only takes place when wheel 11 has rotated through an angle such that wheel 10 comes into mesh with the last tooth 21 of wheel 11, and the accumulator wheel will be rotated one tooth.

During the time necessary for the card 1 Fig. 5 to move downwards a distance equal to the distance between the perforation 0 and the lower portion *b* of the card, and the perforation 9 of the upper portion *a* of the card (Fig. 3) shaft 12 has completed its revolution, the lever 7 is reset in its initial position and the transfer of the tens is performed.

Cam 17 strikes against the projection 18 of lever 7 and pushes lever 7 counterclockwise until the lower extremity of lever 7 is locked in its initial position by the armature 6 of the electromagnet.

When the card has moved downwards until perforation 9 of the upper portion *a* of the card is located under the brush, wheel 11 is exactly in the condition in which it was when the perforation 9 of the lower portion of the card was located under the brush.

If there is a perforation 9 in the upper portion of the card, the wheel 10 will engage wheel 11 as indicated Fig. 6 and the accumulator wheel 14 will be turned 9 teeth forward.

Cam 20 also turns in synchronism with the movements of the card through the machine and opens circuit 4 when the brush is in front of the space between the perforation numbered 0 of a lower portion and the perforation numbered 9 of an upper portion or when the brush is between two cards.

The card feeding device is connected to the totalizer as follows. One end of the shaft 12 is geared to a motor (not shown) which continuously turns the shaft counterclockwise. Fixed to the shaft 12 is a toothed wheel 23 which by the intermediate wheels 24 and 25 is in geared connection with wheel 26 fixed on a shaft 27. Integral with the wheel 28 is a wheel 28 which by the intermediate wheels 30 and 31 is in geared connection with the wheel 32 fixed to the upper roller shaft 33. Wheel 32 is by the intermediate wheel 34 in geared connection with the wheel 35 fixed to the lower roller shaft 36. Wheel 23 is further by the intermediate wheels 40, 41 and 42 in geared connection with the wheel 43 fixed on the shaft 29. All intermediate wheels may turn on pins fixed to a stationary frame not shown. The shafts 27 and 29 and the roller shafts 33 and 38 are rotably mounted on both ends in bearings fixed to the frame. The diameter of wheel 28 is only the half of the diameter of the wheel 26. The shafts 33 and 36 will thus make only half a revolution for each revolution of the shaft 12. The rollers on the shafts 33 and 36 cooperate with pressure rollers 45, 46 said rollers having suitable diameters, in order to feed one card for each second revolution of the shaft 12. On each extremity of shaft 27 is fixed a cam 50 cooperating with a roller 51 on a lever 52, which lever pivots on a pivot 53 fixed to the frame. The left extremity of lever 52 is provided with a roller 54 which may slide in an horizontal groove 55 on the picker 56. The picker may slide up and down on two slides 57 fixed to the frame. When the shaft 27 turns, the cam 50 will turn the lever 52 counterclockwise about the pivot 53 whereby the picker will move downwards introducing a card between the upper rollers 32, 45. The springs 58 move the picker back in its initial position Fig. 6.

Every time an accumulator wheel 14 passes from the position 9 to the position 0, a projection 70 on said wheel pushes against the upper extremity 71 of a wing lever 72 and pivots said lever about an horizontal pin 73 fixed to the frame. To this effect, said extremity 71 of lever 72 is curbed in a direction perpendicular to the plane of lever 72 and to the plane of wheel 14 (Fig. 8), so that in the initial position of lever 72, the extremity 71 is situated in the path of the projection 70. When pivoting, a projection 74 on said lever causes the wheel 75 to slide along the shaft 19, whereby a single tooth 77 on wheel 75 comes in a position in which it will mesh with the accumulator wheel 14 of the next higher decimal order when the wheel 75 is rotated. The rotation of wheel 75 is effected as follows when a value on the card has been entirely entered on the counterwheel 14. The wheel 75 may slide on the shaft 19 in longitudinal direction, but cannot turn on the shaft. On one end of the shaft 19 is fixed a wheel 80 (Fig. 7) adapted to mesh with a mutilated wheel 81 fixed on shaft 12. When the index point position 0 on the lower portion of the card passes the brush 2, the first tooth 82 of the series of teeth 83 will mesh with the wheel 80. The last tooth 84 will move out of mesh with the wheel 80 when the index position 9 on the upper portion of the card passes the brush. The cam 17 on the shaft 12 will reset the levers 72 and the wheels 75 in their initial positions. There is a lever 72 and a wheel 75 for each accumulator wheel 14. On each wheel 75 the single tooth takes a different position.

The ten transfer operation will thus be effected when the blank space on the card between the horizontal portions moves beneath the brush. With an electric ten transfer device, the operation may be executed in a shorter time than for the device described, and said blank space between the portions on the card may be reduced,

A cam **20** closes the contact **90** when an horizontal portion of a card is beneath the brush, but interrupts the contact when the brush is on the blank space between the horizontal portions on the card or in the interval between two cards.

The battery is indicated by **91** Fig. 6.

The tabulating machine of the type described may comprise a usual printing device operated electrically of the well known type. In this case, a magnet actuating a column of the printing device is shunted in the same circuit that actuated the corresponding counter magnet, as shown by **92** Fig. 6.

The main shaft of the printing device may be the same as the shaft **12** and the printing device will perform one cycle for each horizontal portion of a card that passes the analyzing brush **2**.

The operation of such printing device is described in the Patents No. 1,971,858, 1,971,859 and 2,046,464.

When the distance between vertical adjacent index point positions in a column is the same for a card according to Fig. 2 as for a card according to Fig. 3 both cards may operate the same machine. For this purpose, the picker, Fig. 5, is provided with a second projection **94** adapted to move a card of the size shown Fig. 2 downwards between the upper pair of rollers for every downward movement of the picker, when the pile **95** contains such cards of said size. Such cards would pass the brush consecutively for every second cycle of the totaliser.

Without any transformation, the tabulating machine may thus be operated by cards of normal size with two horizontal portions Fig. 2 or by cards of smaller size with a single horizontal portion Fig. 1.

If the machine described is to be operated by a certain number of such small cards of about half the height of the usual card according to Fig. 1, the movement of the picker could be transformed to feed one card for every cycle of the totalizer by substituting the cams **50** by double cams **90** as shown Fig. 6. These double cams would move the picker up and down twice for every revolution of the shaft **21**, that is once for each revolution of shaft **12**.

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