June 16, 1959 J. C. HOSKEN 2,890,651

DATA PROCESSING EQUIPMENT AND METHODS

Filed Oct. 2, 1956 6 Sheets-Sheet 1

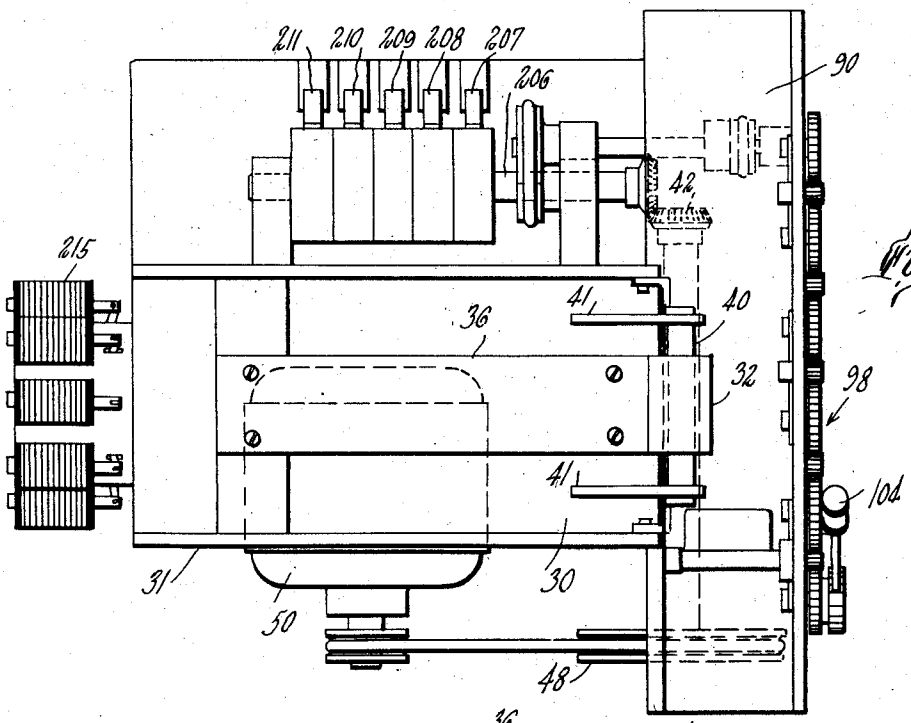

Fig. 1.

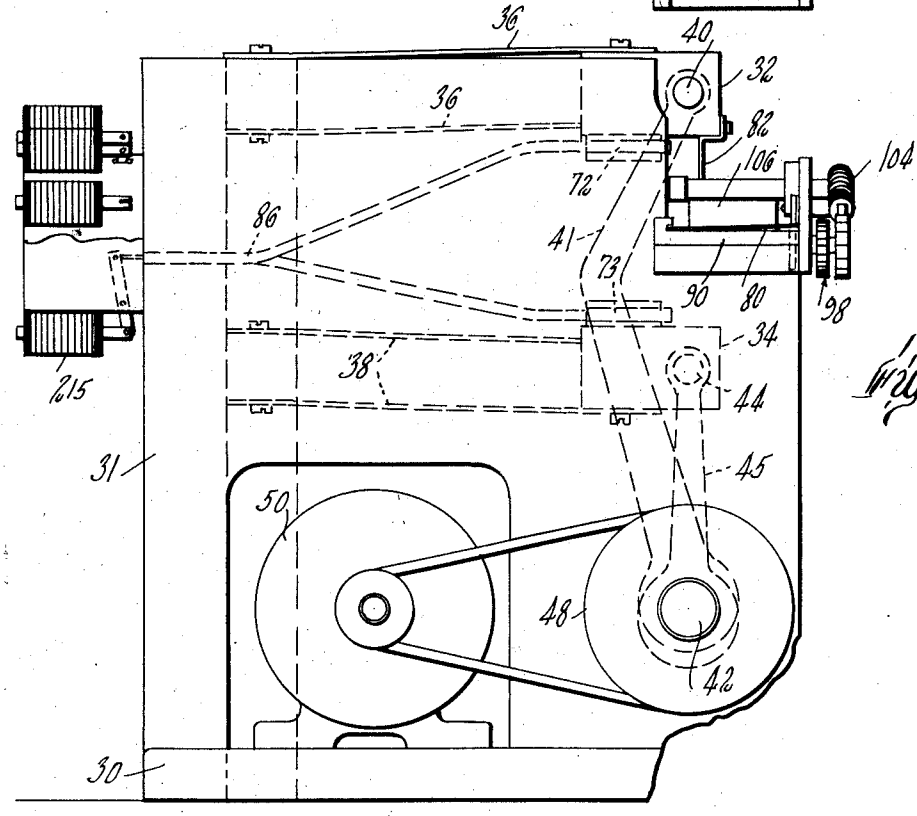

Fig. 2.

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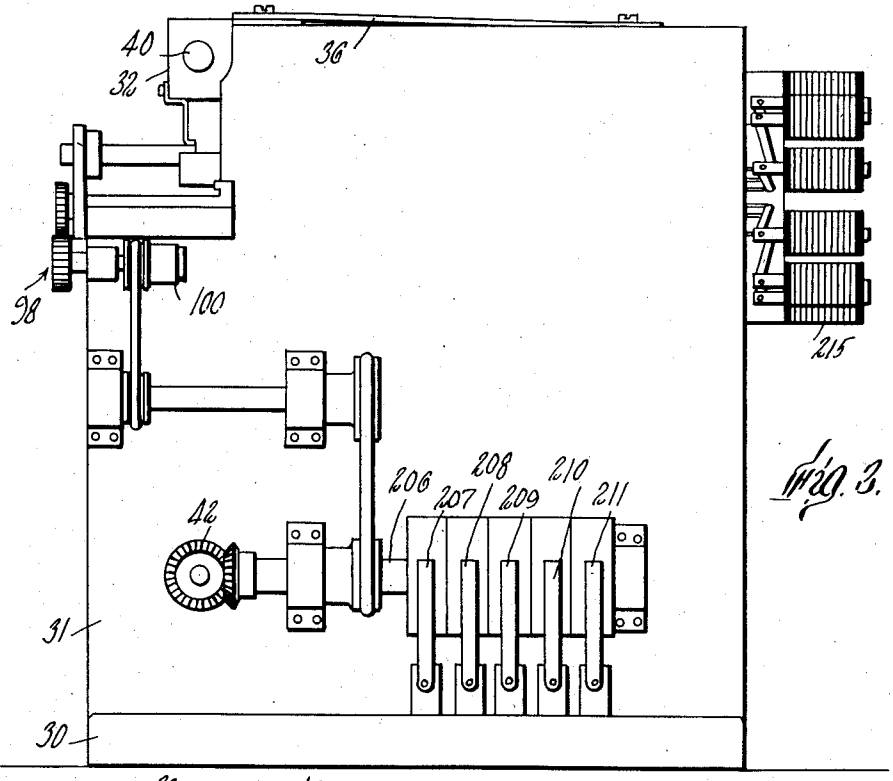

Fig. 3.

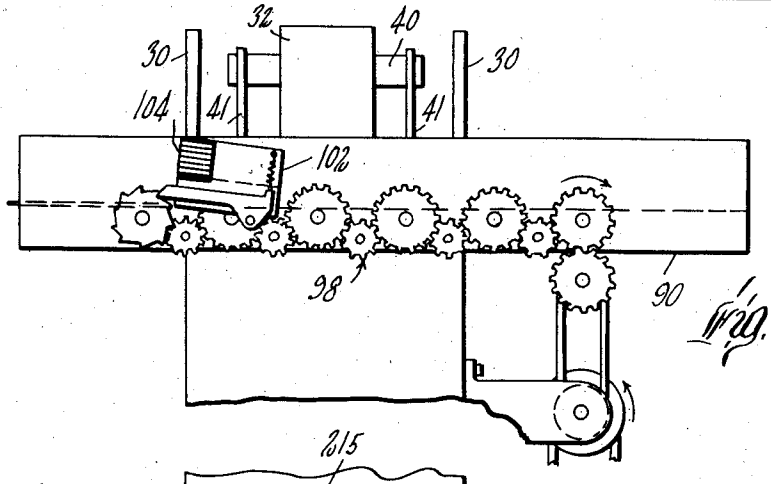

Fig. 4.

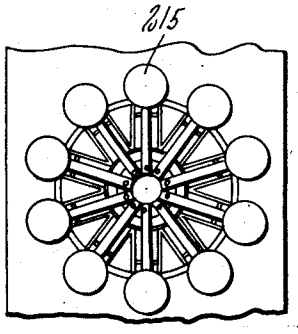

Fig. 5.

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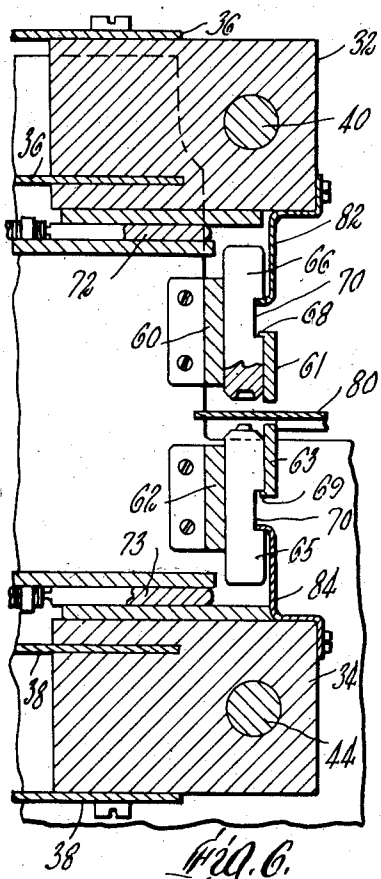

Fig. 6.

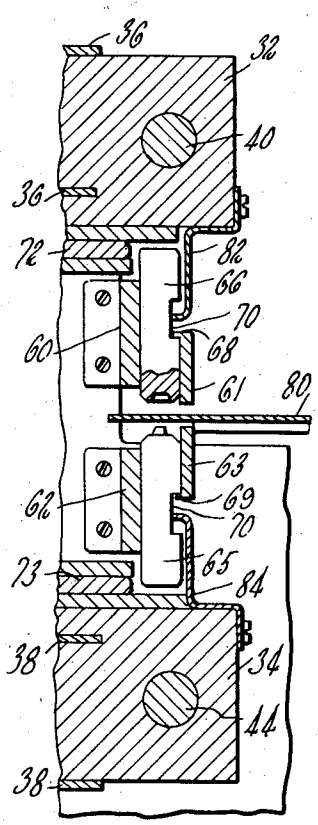

Fig. 7.

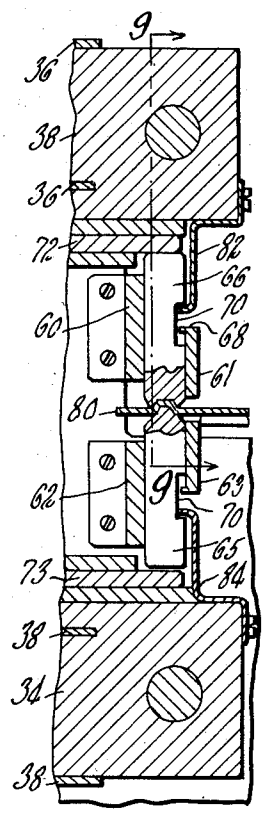

Fig. 8.

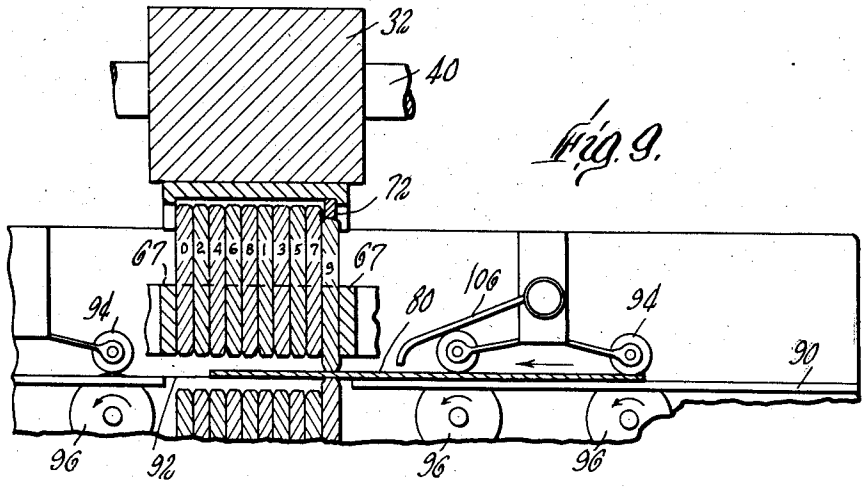

Fig. 9.

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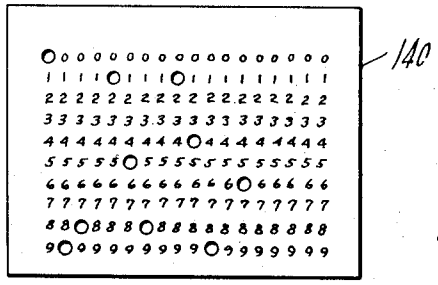

Fig. 10.

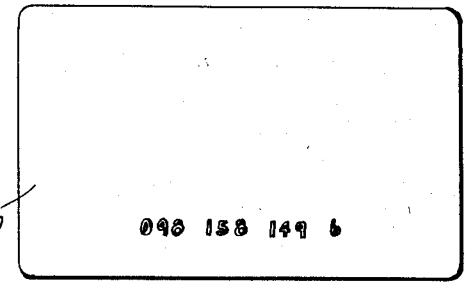

Fig. 11.

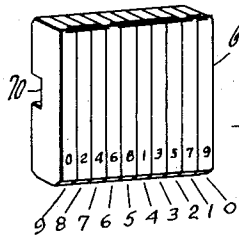

Fig. 12.

Fig. 13.

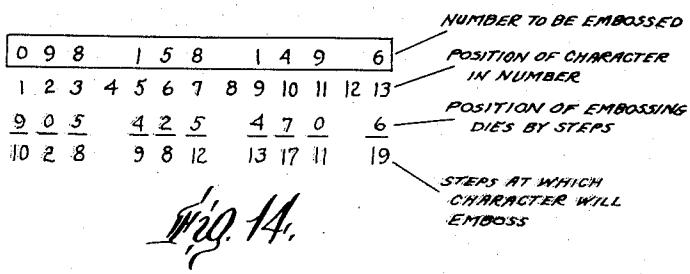

Fig. 14.

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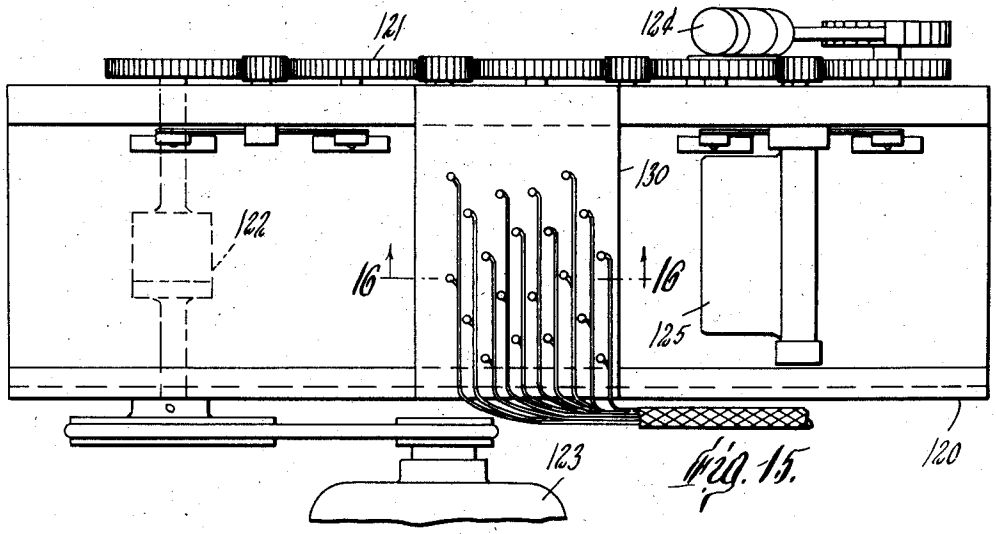

Fig. 15.

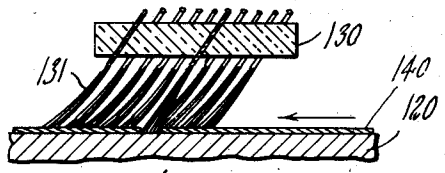

Fig. 16.

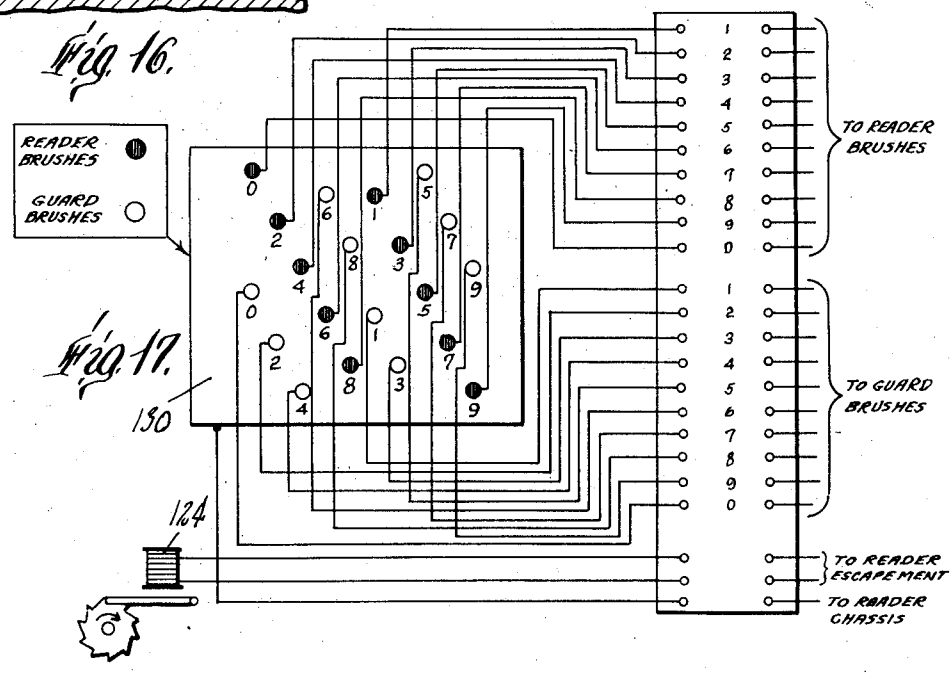

Fig. 17.

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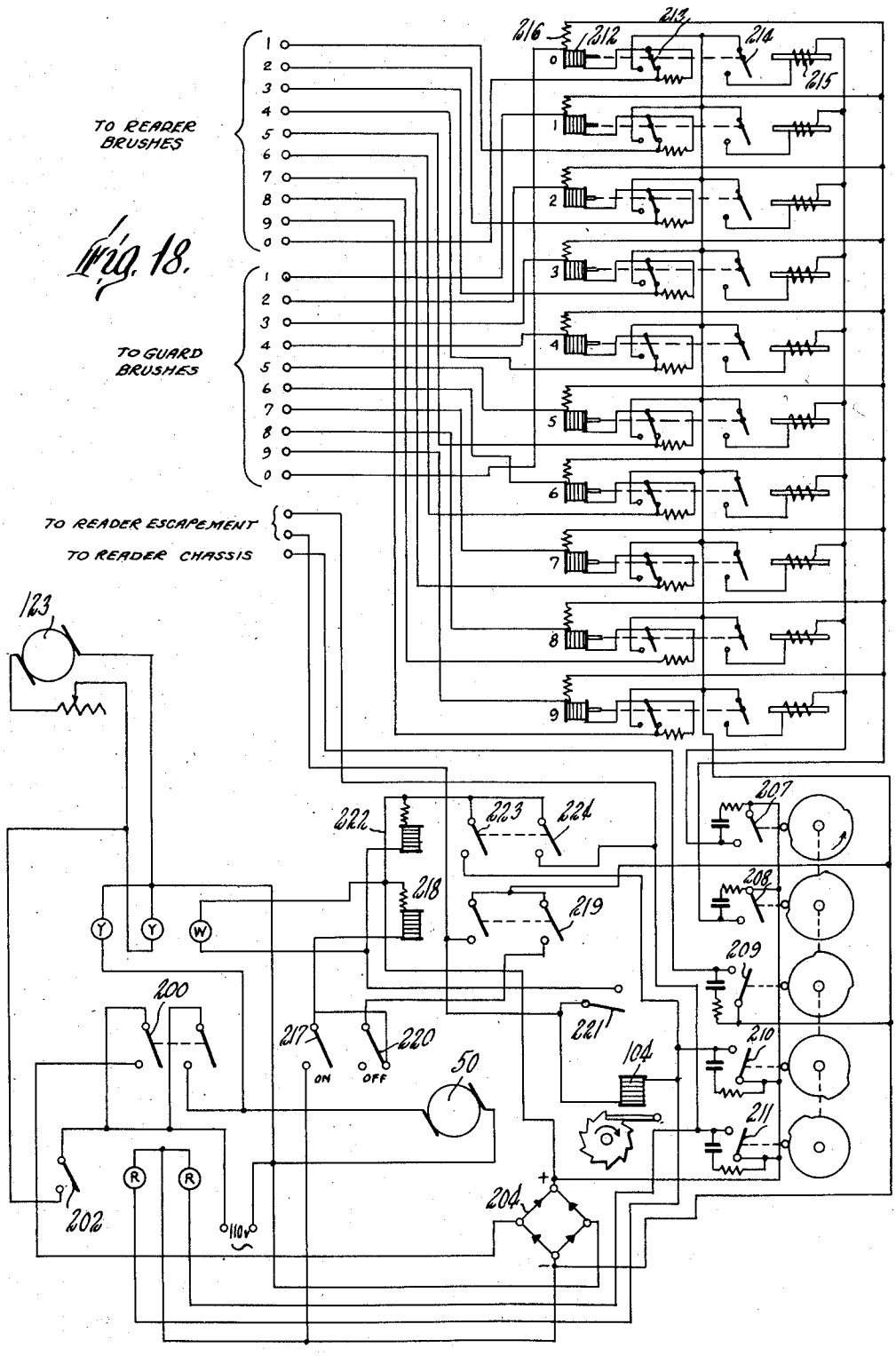

Fig. 18.

United States Patent Office 2,890,651 Patented June 16, 1959

2,890,651

DATA PROCESSING EQUIPMENT AND METHODS

James C. Hosken, Boston, Mass., assignor to Farrington Manufacturing Company, Needham Heights, Mass., a corporation of Massachusetts

Application October 2, 1956, Serial No. 613,461

6 Claims. (Cl. 101—93)

This invention relates to data processing equipment, and more particularly to a method and apparatus for transferring data borne in one form on an intelligence-containing unit to a different form on another unit. Apparatus-wise the invention provides for the rapid automatic successive imprinting on a series of plates or cards, of characters corresponding to those recorded on a series of punched cards. However, the method broadly comprises transcribing information contained on a unit in the form of a series of uniform indicia (e.g. holes in a card) which are spatially distributed in one direction on the unit to differentiate the characters and in the other direction on the unit to indicate the order of characters, into a different form, namely an imprint, of the same characters in normal, legible reading alignment.

It is a primary object of the invention to provide an automatic punched card actuated imprinting machine to replace the present type of manually operated embossing machine that is used in the preparation of embossed printing plates, such as are used in preparing credit cards and addressing systems. The apparatus of this invention is particularly useful where punched cards have anyway to be prepared for other reasons, and hence are available for use in preparing embossed plates or cards.

While automatic operation from punched cards of standard embossing machines has been accomplished, a conventional embossing machine is inherently too slow due to the inertia of its moving parts. When the machine is manually operated, the inertia is not a serious limitation because of the limited dexterity of human operation. Machine actuation is, however, seriously limited in speed by the structure of the embossing machine. Accordingly, I have devised as part of my invention, an imprinting or embossing unit which is not so limited and can operate rather at the much higher speeds at which punched cards may be electrically sensed. And, in doing so, certain fundamentally different principles of both type or embossing die operation, and of sensing operation, have been adopted.

First, the imprinting unit, while having a series of individually different imprinting characters, as in embossing machines and typewriters, maintains each of these characters in an entirely separate individual path of operation—the paths of the characters, in their printing function, never overlap as in a typewriter. A time saving is hence provided because one type does not have to be retracted out of the way before another type can function. In my device, two or more, including all, of the type can imprint simultaneously.

This is accomplished by aligning individual type in a row and actuating them in transverse, parallel, non-overlapping paths. As a result, the font of type is in fixed succession, and if one feeds a card to be printed past the type unidirectionally, the first type in the row can print in the first position on the card only at the first step in the feed, unless provision is made to permit the type to operate in a time sequence which is entirely independent of their succession. Such an independent time

sequence would not be necessary if the card could be reversed in its motion to bring it first under one type and then under an earlier located type. But such reversal of the feed would be time-consuming, for example, if a card had to be fed to the last type to print the first position, and then be reversed to return the card to the first type to type the second position. Unidirectional feeding is much faster.

This invention then provides mechanism controlling the type, which are in such fixed aligned order and which have motion only in parallel very short rectilinear paths, to imprint in a time sequence varying from the order of appearance of the characters on the final printed card, so that a unidirectional fast feed can be utilized. This operative time sequence is not the same as the spatial order of the print on the final card but depends on both this order and the spatial arrangement of the dies in the embossing head.

The operation of the dies is controlled by a sensing mechanism from a punched card which carries character codes in columns in the spatial order in which they are to appear in the final printing, the code arrays in the columns varying according to the particular character each codes.

According to this invention, the information is transcribed from such a punched card without the use of an intermediate memory device. While the card to be printed is carried in steps through the embossing or printing head, the punched card is carried in a synchronized manner through the sensing head. This head has a series of sensing elements or recognition units arranged in succession in the direction of the card advance at intervals equal to the card column center distance, each set of elements sensing only the presence of one specific character, and together arranged in identical succession to that of the corresponding characters in the printing or embossing head. Because of the identity of the order of succession of the printing and sensing elements, and the synchronized feeds, whenever a particular column of the punched card is in position to be sensed by the sensing element corresponding to the character coded in that column, the corresponding position on the printed card is between the dies corresponding to the required character; the sensing element signals to the corresponding printing element which then prints or embosses the character in the right place. In a similar way all the other required characters are printed in their right places without any reversal of the movement of either card.

It is thus a further object of the invention to provide a method and apparatus for reading punched cards, wherein a sensing head is utilized which has only a single separate recognition unit for each character which determines merely whether or not any column in the punched card does or does not contain the particular character to which that recognition unit is assigned, and wherein the units are arranged in succession in the direction of the feed of the punched card. Heretofore, punched card reading mechanisms have been complicated by the fact that in reading the card the sensing head had to differentiate between various characters contained in one column, depending upon which of many characters were contained in that column. All that each recognition unit does in my head, for each column, is to make a positive or negative determination—is its character in that column or isn't it.

Since each position to be embossed passes once only between each pair of dies and since the corresponding column of the punched card passes at the same time under the corresponding reading head unit, all the characters in the punched card field will be embossed in similar spatial order on the embossed card by the time it has passed completely between the dies.

Additional lines of information can be embossed by

passing the card through other embossing heads offset from the first, provided the corresponding fields of the punched card are driven in synchronism through other sensing heads.

Punching or printing heads can be substituted for the embossing heads.

These operations will be more clearly understood by reference to the accompanying drawings, wherein,

Fig. 1 is a plan view of an imprinting mechanism of the invention;

Fig. 2 is a side elevational view of the mechanism shown in Fig. 1;

Fig. 3 is a side elevational view of the other side of the mechanism shown in Fig. 1;

Fig. 4 is a front elevational view of a detail of the mechanism shown in Fig. 1;

Fig. 5 is a detail of a sub-assembly of the mechanism shown in Fig. 1;

Figs. 6, 7 and 8 are enlarged detailed views, Fig. 6 being partly in cross-section, illustrating various positions of the structure in the operation of the imprinting head of the mechanism of Fig. 1;

Fig. 9 is a cross-sectional view taken along the line 9—9 of Fig. 8 and showing part of the feed mechanism;

Fig. 10 is a plan view of a conventional punch card, punched in code to record the number 098 158 149 6;

Fig. 11 is a plan view of a plate or card which has been imprinted with the number coded on the punched card of Fig. 10;

Fig. 12 is an enlarged perspective view of a font of type in certain order of succession;

Fig. 13 is a chart graphically illustrating the operation of the mechanism of this invention in transcribing the aforesaid number from the punched card onto the imprinted card;

Fig. 14 illustrates a manner of determining the chronological time sequence of type operation in imprinting the number recorded on the punched card of Fig. 10;

Fig. 15 is a plan view of the sensing mechanism;

Fig. 16 is an enlarged detail of sensing brushes used in the mechanism of Fig. 15;

Fig. 17 is a somewhat enlarged plan view of the wiring of the sensing mechanism; and

Fig. 18 is a wiring diagram of the circuits associated with the imprinting mechanism.

As shown in Fig. 2, there is provided a frame **30** having an upright rear member **31** on which are suspended two opposed imprinting heads—an upper head **32** and a lower head **34**. These heads are suspended for up and down opposed motion towards and away from each other on parallel pairs of resilient spring arms **36, 36** and **38, 38** respectively. A pin **40** extends through the upper head **32**, the pin being connected on each side of the spring supports **36** to two downwardly extending arms **41**, the lower ends of which are eccentrically mounted on a drive shaft **42**.

The lower head **34** similarly has a pin **44** to which are connected arms **45**, also mounted for eccentric motion on the shaft **42**. The shaft **42** is driven through pulley and belt connection **48** to a drive motor **50**. The motor **50** is driven at constant speed so that the opposed heads **32** and **34** rapidly move towards and away from each other.

Referring now to Figs. 6 to 9, type or die magazines are provided below the upper head and above the lower head. These magazines are stationary, being mounted on the frame and comprising a rear wall **60**, an opposed front wall **61**, the corresponding parts of the lower magazine being **62** and **63**; and end walls. The opposed fonts of type, being, for the purpose of embossing, lower male dies **65** and upper female dies **66**, are enclosed within these hollow stationary magazines, the end walls of the upper magazine being shown in Fig. 9 at **67, 67**. In order to limit the retraction of the dies **65** and **66**, the front stationary walls **61** and **63** have rearwardly extending flanges **68** and **69** respectively, which extend into grooves **70**, provided in both sets of dies.

Figs. 6 and 9 show the head **32** (and head **34** in Fig. 6) in retracted position, while Figs. 7 and 8 show them in closed positions. The sets of dies, however, are frictionally held in their respective stationary magazines, and they do not normally move with the rapid reciprocation of the opposed heads. When it is desired that a particular pair of dies function, they are moved by the heads. To secure such movement there is provided over the upper set of dies a set of interposers, one of which is shown in Fig. 9 at **72**. These interposers are actuated by means hereafter described, so that they are interposed between the head **32** and the individual die to be actuated, while simultaneously a lower interposer **73** (Fig. 8) is moved between the lower head and the lower mating die. Their movements to the interposed positions are shown in Fig. 8. When the interposers **72, 73** are in these positions, as the heads close, the dies are brought together to emboss an interposed card such as **80**, as shown in Figs. 8 and 9. If desired, the separate dies may be separated by interposed stationary shims (not shown).

The two heads are also provided with retractors **82** and **84**, which have fingers extending into the grooves **70** of the die sets, so that whenever a pair of dies is in closed position at the time of retraction of the heads, the fingers of retractors **82** and **84** will engage the remote walls of the grooves and retract the dies with the heads. The retractors also function to prevent inadvertent motion of the dies towards each other.

The sets of interposers **72** and **73** are connected by flexible cables to a circular array of solenoids at the rear of the mechanism. As shown in Fig. 5, there are ten solenoids and each solenoid is connected by a flexible branching cable **86** (Fig. 2) to an opposed pair of dies, so that each opposed pair of dies can be independently moved with the heads.

Feed mechanism for embossing mechanism

As shown in Fig. 9, there is provided a stationary plate **90** forming a runway on which the cards **80** may be fed between the opposed sets of embossing dies, the plate being apertured at **92** to permit the dies to emboss the card **80** as it passes over the aperture. The feed mechanism may be any conventional step-by-step unidirectional feed. I have illustrated for this purpose a series of overlying spring-pressed rollers **94** and a series of underlying driving rollers **96**. The rollers **96** are driven from a gear train **98** (Fig. 4) which is operated from drive shaft **42** through gear pulley connections shown in Fig. 3. **100** indicates a friction clutch so that the gear train would be constantly operated were it not for the provision of an escapement **102**, shown in Fig. 4, which is intermittently actuated by an electromagnet indicated at **104**. The escapement thus, with the interposition of the friction clutch **100**, provides for intermittent drive of rollers **96**, and hence causes step-by-step advance of the card **80** through the embossing head.

Also shown in Figs. 2 and 9 is a start-feed gauge **106** for properly positioning a card to start its feed to the embossing head. As will be hereinafter explained, the timing of the escapement **102** is such that, with respect to the position of the card at the feed stop **106**, the card will be fed in such manner that each time the heads close, the card will be stopped and will be moved, as the heads retract, a distance equal to the uniform spacing of the dies.

Sensing mechanism

The solenoids of Fig. 5 above referred to are actuated in proper time sequence from the sensing mechanism shown in Figs. 15–17. This mechanism includes a frame **120** having a runway for feeding punched cards from

right to left, as shown in Fig. 15, by a roller feed mechanism similar to that used in the embossing mechanism, and including gear train **121**, friction clutch **122**, drive motor **123**, escapement **124**, and feed stop **125**. Above the path of the punched card is an insulating plate **130** through which extend brushes **131**, in a pattern arrangement, and arranged to make electrical contact through the punched card with the frame **120** when a hole passes underneath a brush.

The pattern of brushes is selected with particular regard to the type of punched card which is to be sensed.

One conventional type of punched card is shown in Fig. 10, where the circles represent holes. Here the horizontal rows indicate different digits, the vertical columns indicate from left to right the order in which the digits appear in the number recorded and their spacing. Thus the recorded information on the card **140** is the number 098 158 149 6. The card can be read though the holes are uniform in size and shape; the reading is dependent on the location of each hole. In order to properly sense this type of punched card, the brushes may be arranged for example in the pattern shown in Fig. 17. The reading brushes (shown hatched) are in staggered relation across the plate **130**, so that the 9 brush is on one side of the plate and the other numbers appear in chronological decreasing sequence at points which are spaced apart laterally at intervals equal to the distance between the horizontal rows on the punched card. The reading brushes are also spaced longitudinally in the order, from right to left, 9 7 5 3 1 8 6 4 2 0, at uniform intervals equal to the distance between the vertical columns on the punched card **140**.

In order to prevent any actuation of the solenoids when there is no card in the reading mechanism, each character is assigned a second guard brush in a different lateral position from its reading brush so that the solenoid will be actuated only when the reading brush makes contact and the guard brush has no contact. As shown, each guard brush senses each column at the same time as its corresponding reading brush. Each reading brush is connected to the solenoid which actuates the interposers for its corresponding character in the set of dies. The succession of the characters in the font of dies is identical with the order of the reading brushes from right to left in the direction of feed of the punched card in the sensing mechanism. Any character of the dies is hence actuated every time and only when its reading brush extends through a hole in the punched card. The escapements are synchronized so that for every advance of the punched card a distance equal to that between its vertical columns, the card to be printed **80** advances a distance equal to that between the pairs of dies.

In order to explain the operation in the case of the particular card **140**, there is shown in Fig. 13 a graphical illustration of the operation, wherein each horizontal row going downwardly represents a step-by-step advance of the punched card from right to left through the sensing mechanism, while simultaneously a card to be printed is similarly fed step-by-step between the dies, as shown in Fig. 9.

Because the digit 9 appears in the second position in the number to be printed, it does not print when the first punched card column reaches the first 9 sensing brush, but waits until the next step and then prints.

The zero at the first position cannot be printed until the first position on the blank card **80** reaches the last pair of dies. But the zero will print the first and only time that the first position on the blank card **80** comes between the zero set of dies, which, as shown by the chart, will occur at the tenth step, at which step the first punched card column first reaches the zero sensing brush. Meanwhile the 5 and 8 dies have printed at the eighth step, whereas the 1 prints at the ninth step, the 0 at the tenth step, the 9 prints again at the eleventh step, the 8 again at the twelfth step, the 1 again at the thirteenth step, the 4 at the seventeenth step, and the 6 at the nineteenth step, which completes the printing of the ten digits of the number recorded on the punched card.

The following table shows the time squence of printing this number using the type 0, 1, 4, 5, 6, 8, 9:

Order of Digits	Time Sequence	Step
0	9	2
9	8, 5	8
8	1	9
1	0	10
5	9	11
8	8	12
1	1	13
4	4	17
9	6	19

As indicated by Fig. 13, no embossing takes place at steps 0, 1, 3–7, 14–16, or 18.

The information contained in the table just given is illustrated differently in Fig. 14, where it is shown that the time sequence of the actuation of the individual dies is determined by the chronological order of the sum of the position of a digit in the number to be printed and the position of the die in the succession of dies, counting the first die as being zero in the succession. Thus it is shown that the last number to be printed, the 6, is, with the spaces, in the 13th position; the 6 dies are, however, as shown in Fig. 12, 6th in succession. The sum of 13 and 6 is 19, which, as shown by the chart of Fig. 13, is the step at which the 6 will be imprinted. The sums shown in Fig. 14 are set forth in time sequence in downwardly reading order in the above table.

In order to further illustrate the operation of the machine, one might consider how the number 9753186420 would be printed. In this case, since the order in the final number is identical with the sequence of the dies and there are no spaces, die 9 will print at the first operating step; each subsequent die will print at every alternate later step. On the contrary, if the reverse of the number is to be printed, i.e., 0246813579, the punched card and the card **80** to be printed will both progress ten steps and then all the dies will be actuated simultaneously. It should be understood that in Fig. 9 the bottom of the card **8** of Fig. 11 is toward the viewer. Because Fig. 9 is a view looking out from the rear of the embosser, the dies are arranged upside down when viewed from the front of the embossing machine.

Electrical circuits

Fig. 18 shows the electrical circuits for operation of the machine. Power is taken from a source connected to the embossing motor **50** through one side of a double contact switch **200**. A separate switch **202** is provided for separate start of the reader motor **123**. The left pole of the double contact switch **200** energizes the rectifier power supply **204**.

As shown in Fig. 3, a cam shaft **206** driven by the drive shaft **42** of the embossing mechanism operates a series of five switches, the contactors being represented in Fig. 3 at **207**, **208**, **209**, **210** and **211** and also being shown in Fig. 18 in juxtaposition with their respective actuating cams.

Contactor **211** controls the operation of the reader feed escapement **124**.

Contactor **210** controls the operation of the embossing mechanism escapement **104**.

Contactor **209** closes the circuit between the sensing bed **120** and the negative side of the power supply.

Contactor **208** closes the circuit between the power supply and one side of each solenoid relay operating coil.

Contactor **207** closes the circuit between the power supply and one side of each solenoid operating coil.

The ten solenoid relays with their contacts for energizing the solenoid coils are shown in the upper right hand part of Fig. 18. It will suffice to describe only one

of these series. Thus, there is a solenoid relay coil 212 which operates two contacts 213 and 214.

The 214 contactor closes the circuit to the solenoid operating coil 215.

The contactor 213 is the relay hold contact.

Considering one cycle of the embossing mechanism starting with the heads in closed position, the first operation is the sensing feed escapement 104, which is switched by the cam contactor 211 to feed the punched card.

The second operation is the closing of switch 209 which connects the bed plate of the sensing mechanism 120 to the negative side of the power supply.

The third operation is the closing of switch 208 which connects one side of each solenoid relay coil 212 to the positive side of the supply. At this point the relays corresponding with the brushes which are making contact through holes, operate.

The fourth operation is the closing of switch 207, which connects one side of the solenoid operating coils to the positive side of the power supply. At this point, the solenoids corresponding with the operated relays will operate to actuate the particular interposers to which they are connected.

The fifth operation is to make the contactor 210, which operates the embosser feed escapement to move the embossed card again.

The sixth operation is to disconnect the sensing mechanism bed plate from the power supply and thus to protect the brushes from possible arcing when the circuits connected with them are broken. The operation does not release the operated relays which are held on by their hold contacts.

The seventh operation is the opening of switch 207 which cuts off the power from the solenoid operating coils and permits the interposers to retract.

The eighth operation is the opening of switch 208 which cuts off the power supply to the solenoid relay operating coils. At this point, the cycle is complete.

The approximate time relationship of the five cams and the cam shaft is indicated in Fig. 18.

The operation of the guard brushes is as follows:

In series with each relay operating coil is a resistor 216. If the junction between the resistor and the operating coil is connected directly to the negative side of the power supply, the current will flow through this connector rather than through the coil, and the coil will not operate. The guard brushes make this contact, unless the punched card is between them and the sensing mechanism bed. The guard brush corresponding to each sensing brush is in such a position that the card reaches it at the same time that it reaches the sensing brush. Sensing brushes cannot, therefore, operate their relays unless they are making contact through a hole in the card.

In order to allow cards to be put in position at the beginning of the embossing operation, a relay operated start-stop device is used to control the escapements. When the on pushbutton 217 is pressed, the relay 218 operates, and its hold contact 219 keeps in operation until the hold circuit is broken by the off pushbutton 220.

As soon as the embossing operation is completed, the forward edge of the embossed card closes a switch 221, which operates relay 222. The two contacts of this relay 223 and 224 operate the embosser and sensing escapement magnets respectively. This has the effect of feeding both cards continuously and rapidly until the embossed card passes switch 221.

I claim:

1. Data processing equipment for transcribing information recorded on punched cards in the form of holes punched in uniformly spaced columns to indicate order and in different columnar array to indicate different characters, comprising a sensing mechanism including a sensing head having discrete recognition units for different characters represented by said varying columnar arrays of holes in the punched cards, said units being arranged in longitudinal succession spaced by a distance equivalent to the spacing between said columns, means for feeding a punched card unidirectionally relatively through said sensing head with every array thereon passing the recognition unit corresponding to that character which such array represents, an imprinting mechanism comprising a font of type having individually different characters corresponding also to the characters represented by the arrays in the punched cards and by the recognition units, said type being set up in uniformly spaced alignment, the order of succession of the type characters being identical with the order of succession of the individual recognition units for such characters in said sensing head, the characters of said front being individually movable through separate parallel imprinting paths, means for feeding a material to be printed unidirectionally step-by-step relatively across said parallel paths a distance equal to the spacing of said type in each step, means synchronizing the respective relative feeds of said punched card and of said material so that, for each step movement of said material, said card is fed a distance equal to the spacing between its columns, and type activating and operating means connecting each of said recognition units with its corresponding character in said font of type for moving said character, during the interval between movement of said material, responsive to every relative passage of a columnar array in said punched card corresponding to said character by its recognition unit, whereby upon completion of movement of said punched card through said sensing head, said material will bear a composite aligned imprint of the information coded on said punched card.

2. Data processing equipment is claimed in claim 1, wherein said font of type is supported for movement through said parallel paths in a stationary magazine.

3. Data processing equipment as claimed in claim 1, wherein said imprinting mechanism includes pairs of parallel opposed dies mounted for movement from relatively retracted positions towards each other to emboss a material fed between said dies by said material feeding means.

4. Data processing equipment as claimed in claim 3 including a pair of opposed reciprocating heads moving continuously towards and away from each other in cyclical synchronism with the step-by-step feed of said material, said dies being mounted in stationary magazines, and a series of pairs of interposers selectively moveable between said reciprocating heads and said dies, and said type activating means moving selected individual pairs of said interposers between said dies and said heads during selected reciprocations of said continuously moving heads.

5. Data processing equipment for transcribing information recorded on punched cards in the form of holes punched successively in uniformly spaced columns to indicate order and in different uniformly spaced rows in the columns to indicate different characters, comprising a sensing mechanism including a sensing head having a single separate recognition unit for each character represented by the holes in the punched cards, said units being arranged in lateral succession spaced by a distance equivalent to the spacing between said rows and in longitudinal succession spaced by a distance equivalent to the spacing between said columns, means for feeding a punched card unidirectionally relatively through said sensing head with every hole thereon passing the recognition unit corresponding to that character which such hole represents, an imprinting mechanism comprising a font of type having individually different characters corresponding also to the characters represented by the holes in the punched cards and by the recognition units, said type being set up in uniformly spaced alignment, the order of succession of the type characters being identical with the longitudinal order of succession of the individual recognition units for such characters in said

sensing head, the characters of said font being individually movable through separate parallel imprinting paths, means for feeding a material to be printed unidirectionally step-by-step relatively across said parallel paths a distance equal to the spacing of said type in each step, means synchronizing the respective relative feeds of said punched card and of said material so that, for each step movement of said material, said card is fed a distance equal to the spacing between its columns, and type activating and operating means connecting each of said recognition units with its corresponding character in said font of type for moving said character, during the interval between movement of said material, responsive to every relative passage of a hole in said punched card corresponding to said character by its recognition unit, whereby upon completion of movement of said punched card through said sensing head, said material will bear a composite aligned imprint of the information coded on said punched card.

6. Data processing equipment as claimed in claim 5, wherein the means for feeding said punched card operates to feed said card with step-by-step movement synchronized with the step-by-step movement of said material.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

June 16, 1959

Patent No. 2,890,651

James C. Hosken

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 23, after "connecting" strike out "each of"; line 24, for "with its corresponding character" read -- with corresponding characters --; line 25, for "said character" read -- the characters --; line 28, for "said character by its" read -- such characters by the corresponding --; line 33, for "is claimed" read -- as claimed --.

Signed and sealed this 22nd day of December 1959.

(SEAL)
Attest:

KARL H. AXLINE
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