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CHARACTER ANALYZING SYSTEMS

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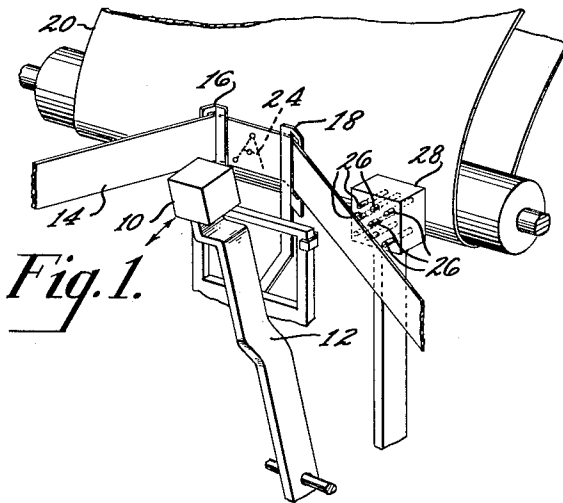


Fig. 1.

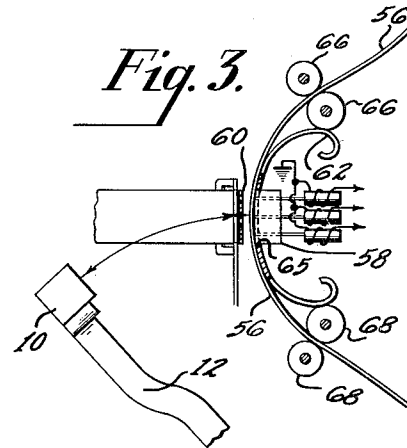


Fig. 3.

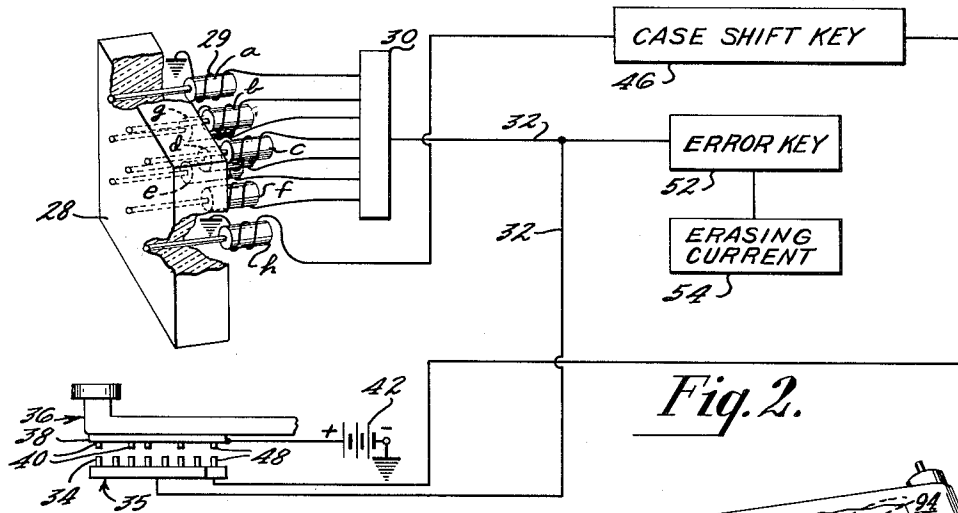


Fig. 2.

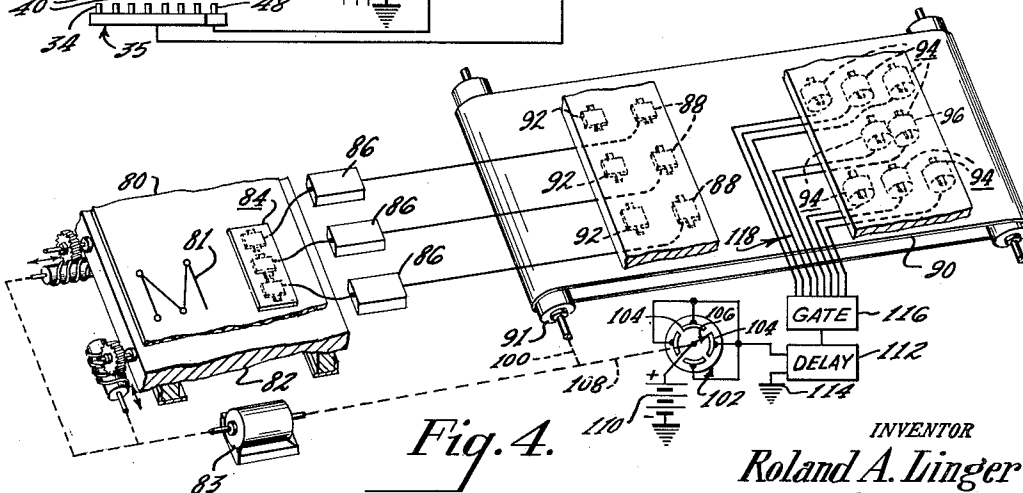


Fig. 4.

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CHARACTER ANALYZING SYSTEMS

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9 Claims. (Cl. 178—23)

This invention relates to printing apparatus and more particularly to apparatus for simultaneously printing and encoding characters for reading by automatic apparatus.

In the field of modern business there are many instances in which the reproduction of material from material already printed is required. Thus in the newspaper business, a reporter usually first types his report on a typewriter and the report is subsequently retyped by an operator on a typesetting machine. Similarly, in telegraph offices a message is typed at the reception point and then retyped by the operator of the teletypewriter transmitting apparatus. Still other examples of situations requiring the copying of typed material into a form which is to be transmitted or used by accounting machines will readily occur to those familiar with the problems of business.

In all of these situations trained operators are required for transcribing the typed matter into their particular apparatus. However, in such transcription there is always present the human factor with its predilection for error. To avoid such errors and to speed the process of transcription, systems for automatic transcription have been proposed which utilize control patterns for typewritten characters which can automatically operate the reproducing apparatus. Several such systems are described by M. Maul in his U. S. Patent No. 2,000,403 which makes use of an optical analyzer. In one of these systems, the optical analyzer was made to observe printed characters wherein the characters were differentiated from each other by varying their relative sizes. Thus, with each character covering a different percentage of a standard field, an analyzing beam was directed with uniform intensity at all portions of the field. Accordingly, the quantity of light reflected toward a photocell unit varied according to the portion of the field area covered by the character. In this system, only one photocell is required for each analyzing mechanism.

In another system described by Maul, four imaginary index points were arranged in the field of each character. Then each character, when printed, would cover one or more of these index points depending on the contour of the character, thereby providing a different code for each character tabulated. Photocells were arranged so that each received reflected light from one of the index point positions of the character field. All of these systems, while quite satisfactory, require relatively elaborate and expensive equipment for accurately placing the characters or code on the paper in the proper position, as little tolerance is allowed. Also each require a separate control pattern which is generally limited in the amount of information the pattern can carry.

Another type of analyzing or reading system has been provided which is not limited to numerals and fixed areas. This arrangement is described in Patent No. 1,815,986 wherein a telegraph reading machine is disclosed. In this system, a typewritten message may be placed in an analyzing device, wherein each letter of the message is scanned by a typical perforated disc television type scanner. The characteristics of the scanned letters vary the

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scanning output signal which controls the operation of code selector elements to send out a representation of the scanned characters.

While these optical systems for reading typewritten characters from sheets of paper can carry a large amount of information and have thus been a great improvement over the use of control patterns, they also have several limitations. One of these is that a large scanning head is required, whether a head itself is to be moved over the copy, or the head held stationary and the copy moved. Another is that optical scanning equipment is quite costly. Finally, there is the consideration of signal-to-noise ratio. Using the optical method, even assuming the use of an electric typewriter with firm pressure, the ratio of reflectivity (for reflected light) or opacity (for straight through transmission) of the inked spots, as compared to the uninked portions of the paper is low with a resulting relatively poor signal-to-noise ratio. This objection is particularly emphasized when considering the scanning of a small area such as a dot or a comma. To obtain a favorable signal-to-noise ratio for this character the scanning beam has to be no larger than the dimensions of a dot. This, in turn, would require very accurate vertical alignment, as the scanning mechanism moves horizontally along a typewritten line.

In an application of Jones, Ser. No. 296,128, filed June 28, 1952, there is disclosed and claimed a printing system for magnetically encoding typewritten information. The present application is an improvement thereover.

Jones describes a method and apparatus for magnetizing code positions in typewritten characters so that the print may then be read directly by a magnetic pickup head. Specifically, the type face of each individual type is provided by preselected magnetic spots, these spots having been arranged to have an individual code configuration for each character. The typewriter is provided with an inked ribbon having powdered magnetized material mixed with the ink. Thus when pressed against the paper by the type character both the magnetic material and ink are deposited on the paper, and because of the magnetized spots on the type face, corresponding magnetized spots result in the characters on the paper copy. The paper may then be read visually as well as scanned by a magnetic pickup head from which coded pulses are obtained that are representative of the characters scanned. These pulses may be used to operate an automatic typesetter, a telegraph, or other similar automatic equipment.

In this apparatus, the permanent magnets, which are embedded in the typewriter keys, are subject to a constant repetition of blows in the typing process. This may result in the magnets losing a portion of the magnetism. Further, placing the magnetic inserts with the typewriter keys would tend to weaken the key construction causing them to wear out at an earlier date.

Accordingly, it is an object of this invention to provide an improved system for magnetically encoding printed information.

It is another object of this invention to provide an improved apparatus for printing and simultaneously encoding characters requiring a minimum amount of maintenance and repairs.

These and further objects are achieved, in accordance with the present embodiment of the invention, by providing an apparatus for electromagnetically magnetizing code positions in the areas of typewritten characters. A plurality of electromagnets are arranged to cover an area substantially equal to the area covered by the largest printed character. These electromagnets are placed behind the area where the characters are printed. The electromagnets in the arrangement are selectively energized, according to and simultaneously as the character

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is printed, to produce an individual code configuration of magnetized spots for each character on the paper copy. This selective energization is accomplished by a selector circuit which is actuated by the printing of a character. The printed copy may be then scanned to produce control functions to actuate any subsequent reproducing apparatus.

Further objects of this invention, as well as a better understanding thereof, will become apparent from the following description considered in conjunction with the drawings in which:

Fig. 1 is a drawing showing a portion of a typewriter modified in accordance with the invention;

Fig. 2 illustrates a selector circuit used in conjunction with Figs. 1 and 3 of the invention;

Fig. 3 illustrates another arrangement of the invention with standard type; and,

Fig. 4 is a schematic diagram of a reading circuit that may be utilized with this invention.

The invention is most easily described in an arrangement which employs a typewriter somewhat similar to present types. However, it is to be understood that the principles of the invention are equally applicable in any printing system that utilizes characters, ink, and causes the characters to be imprinted on paper or other suitable material.

Referring now to Fig. 1 there is shown a portion of a typewriter modified in accordance with the invention. Therein may be seen a character type face 10 of a standard type key 12, only a portion of which is shown. An inked ribbon 14 held by ribbon guides 16 and 18 is positioned in front of a sheet of paper 20. The paper 20 is impregnated with magnetizable material which may be of the type used in making magnetic tape or magnetic sound tracks on film. In the normal operation of the typewriter, the type face 10 of the type key 12 is caused to strike the paper through the ribbon, thereby imprinting a character 24 (shown here in dotted lines as the letter A) on the paper for visual reading.

A plurality of electromagnets 26 are positioned with their poles in a nonmagnetic plastic block 28. The plastic block 28 is mounted on the typewriter on the keyboard side of the paper 20 so that the pole tips of the electromagnets are perpendicular to and immediately adjacent the paper in the area where the character 24 is printed. The exact location is slightly to the right (or to the left) of the character printing area (shown here as to the right) so as not to interfere with the operation of the inked ribbon.

The operation of this arrangement may best be understood by referring to Fig. 2 which shows a schematic diagram of the apparatus used to selectively energize the electromagnets. Here the electromagnets in plastic block 28, bearing reference letters "a" through "h," are shown in perspective. They are in the same positions they occupy in Fig. 1, viewing plastic block 28 from the back or paper side. Eight electromagnets are shown for purposes of illustration only since more or less than eight electromagnets can be used, depending upon the code combination to be established. The eight electromagnets enable a convenient representation using binary principles to accommodate all of the normal characters of a typewriter plus the indication of the case of the character and the indication for "line return." Further, this arrangement requires only 3 vertical levels. This allows greater ease of operation since the index points are farther apart and, therefore, do not require precise vertical alignment of reading apparatus in the scanning process.

Each electromagnet or digit, when in position, has a value assigned to it in the binary system. Allowing six of the eight digits to represent the letters of the alphabet and associated symbols and numerals, the upper left digit "a" represents the binary one, the upper center digit "b" represents the binary two, the upper right digit "c" represents the binary four, the center digit "d" represents

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the binary eight, the lower left digit "e" represents the binary sixteen, and the lower center digit "f" represents the binary thirty-two. In addition to these number values, the center left position "g" could be used to indicate capitals, and the lower right position "h" for "line return."

In this type of code representation, a different binary value is assigned to each character such as will allow the digits to fall on the character outline. Thus for the letter "A," shown in Fig. 1, the upper center, the center, and the lower left digit or electromagnet positions are used which have binary values of two, eight, and sixteen, respectively. This causes the total binary value of the letter "A" to be twenty-six. The code digit representation for the remaining symbols is established in this same manner, and is completely described in the copending application of L. F. Jones cited above.

There are many known ways in which the operation of a character key may be arranged to cause actuation of predetermined ones of the electromagnets. Fig. 2 merely shows one such selector contact arrangement for accomplishing this purpose. Each electromagnet is provided with a winding 29, one side of which is connected to ground. The other side of seven of the windings are connected to a junction box 30 where they are combined to form a cable 32. The cable is connected through a junction box 35 to a series of contacts 34 mounted under key bar 36 of each typewriter finger key. The cable connects the winding of each individual electromagnet to one of this series of contacts which are mounted on junction box 35.

Each key bar is provided with a conducting plate 38 and, extending downward from the conducting plate, cooperating contacts 40 are arranged in different combinations for each key bar. Thus, for the key bar shown, the first, third, fourth and sixth contacts would be closed upon striking that key bar. Each conducting plate is connected to a battery 42, the other side of which is connected to ground to complete an electrical circuit through the windings of those electromagnets whose key bar contacts are closed. When the key bar is struck, a corresponding character is printed by the typewriter and simultaneously therewith, by the closing of the key bar contacts 34 and 40, certain of the coils of the electromagnets for example, coils b, d, e, and h, are energized.

The eighth electromagnet "h" is utilized to indicate the case of the printed character, i. e. whether it is capital or lower case. The case shift key of the typewriter, represented by rectangle 46, is provided with a single pair of contacts (not shown, but similar to those of the character keys). One of these contacts is connected to the winding of the case indicating electromagnet "h." The other contact is connected to a second pair of contacts 48, which are mounted adjacent each key bar in the same manner as the selector contacts previously described. The upper contact completes the circuit through the conducting plate 38 and battery 42. Thus, although the key bar contacts 48 will be closed each time a character key is struck, the case shift electromagnet will not be actuated unless the case shift key is also depressed.

As a result of the close proximity of the poles of the electromagnets to the paper, points of magnetization will appear in a configuration determined in accordance with the energization of the electromagnets. Essentially, the only changes required in a typewriter are the placing of a block of electromagnets adjacent the area at which the type key strikes the paper, and placing switching means on each typewriter key. No drilling or otherwise weakening of the type faces is required. Further, since the electromagnets receive their magnetism from their windings each time they are energized, they are not subject to losing their magnetism as are permanent magnets.

With such a system, in the event that an error is made, erasure of the printed character will not erase the magnetic recording. Erasure of the magnetic coding may be accomplished by providing an error key 52 which will

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energize all of the electromagnets from a source of erasing current represented by the box 54. The erasing current source may take the form of a high frequency current generator such as that used in the "Type RT 11 2 Professional Magnetic Tape Recorder" and which is described in the instruction book IB-24739-1 for this recorder, published by RCA. However, the invention is not limited to this particular generator since any of the magnetic erasing techniques, which are well known in the art, may be used with this invention.

In another application of the invention, ordinary paper may be used in conjunction with an inked ribbon having magnetic particles mixed with the ink. The powdered magnetic particles may be of the type used in making magnetic tape or magnetic sound tracks on films. A system of this general type is more fully described in the copending application Ser. No. 296,128 of Jones, which has been previously referred to. With such an arrangement, it is necessary, in order primarily to provide a better visually readable copy, to place the electromagnets, so that the energized pole tips lie on the configuration of the character.

Fig. 3 is a side view in section of a portion of a typewriter modified in accordance with this employment of the invention. Here the plurality of electromagnets are arranged in the same manner as shown in Fig. 1, and have their pole tips embedded in a plastic non-magnetic block 53. However, the plastic block is mounted in a fixed position directly behind the area in which the type key 12 strikes. A sheet of paper 56 is mountable on the carriage of the typewriter in between the plastic block and type key 12 in such a manner as to rest against the plastic block 53 to receive the printed characters. The pole tips of the electromagnets extend forward toward the paper but are recessed in and covered by the plastic block so that a smooth typing surface is provided.

An inked ribbon 60 is positioned adjacent the paper on the type key side of the paper. In the normal operation of the typewriter the pressing of a key bar causes the type key 12 to strike the inked ribbon 60, thereby depositing the ink and magnetic material on the paper 64 leaving a visually readable character. At the same time, by means of circuitry similar to the arrangement shown in Fig. 2, selected ones of the electromagnets are energized to magnetize corresponding points of the printed character, as described above.

Because of the fixed position of the electromagnets behind the paper, a modification of the typewriter carriage is necessary. Thus, there is provided a fixed curved support 62 which is made at least twice as long as the width of the paper 56. The curved support, which remains stationary, is provided with a centrally located opening 65 into which the pole tips of the electromagnets in plastic block 53 are positioned. As mentioned above, the pole tips are preferably embedded in a plastic material so as to form, together with the curved support, a smooth surface over which the paper may easily slide.

In order to advance the paper along the line as each character is printed and to advance the paper line by line, there is provided an upper pair of contacting rollers 66 and a lower pair of contacting rollers 68. These rollers are mounted on the carriage by suitable means (not shown) and grip the paper. Thus as the carriage is shifted in the usual manner along a line, the paper is similarly shifted, the curved support remaining stationary. In order to advance the paper line by line, the upper rollers 66 are rotated an amount sufficient to advance the paper the correct amount.

With such an arrangement, it is important that the electromagnets be energized before the carriage has been advanced but not until after the character has been printed. This may be accomplished by any suitable means such as the introduction of delay circuits, or by means of synchronizing circuits which will insure the electromagnets being energized at the proper time.

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In Fig. 4, an arrangement for scanning the paper copy and recording the pulse code output on magnetic tape is shown as illustrative of output apparatus that can be used with this invention. The particular arrangement shown in Fig. 4 is the system disclosed and used by Jones in his copending patent application, previously referred to.

A portion of a paper copy 80 containing the printed and magnetic representation of a character "M" 81 is shown mounted on a scanning platform 82. The scanning platform, driven by a scanning platform drive 83, moves the paper vertically and horizontally under three magnetic scanning heads 84. The character 81 is shown greatly enlarged to illustrate more clearly the magnetic spots, as described above. The magnetic scanning heads 84 are mounted by an apparatus (not shown) above the paper copy 80. The vertical and horizontal movement of the scanning platform causes each line of typewritten characters to be scanned by the scanning heads typically from left to right so as to scan the entire paper copy 80. These scanning heads may be of the type described by Booth in "Electronic Engineering," July 1949, on page 234. The scanning heads, described by Booth, are small and compact, and are particularly applicable to scanning small areas of printed material. However, any other type of magnetic recording pickup which is suitable can be used. It is to be understood that, if desired, the paper may be held stationary and the heads moved over it.

The outputs of the scanning heads 84 are fed individually to amplifiers 86 wherein they are amplified. The amplifier outputs are applied to three recording heads 88 mounted adjacent a continuous magnetic tape 90. The tape is driven by a tape drive 91. The amplifier outputs are on the magnetic tape. An erasing means 92, which may be magnetic pickup heads, permanent magnets, or other magnetic erasing means, is positioned just ahead of the recording heads 88 on the tape so as to eliminate any previously recorded signals. Additional pickup heads 94 which may be of the same type as the scanning heads 84 are positioned to the right of the recording heads 88 along the tape. These heads are arranged to be in reverse to the configuration of the code index positions shown in Fig. 1.

A mechanical coupling 100 is connected between the scanning platform drive 83 and the magnetic tape drive 91, thereby holding the scanning speed and the tape speed in a preselected speed ratio. A commutator 102 having a plurality of switch elements 104 and a rotor 106 is provided. The rotor is adapted to be driven by a mechanical coupling 108 connected between the rotor 106 and the scanning platform drive 83.

The rotor is electrically connected to the positive terminal of a battery 110, and each switch element of the commutator is connected to the input of a delay circuit 112. A ground connection 114 on the delay circuit completes a circuit from the positive side of the battery to the negative side of the battery which is also grounded. Since all the typewritten characters are equally spaced, synchronizing pulses, corresponding to each typewriter character position, are generated as the scansion takes place by selecting the proper number of switch elements for the rotor speed.

The delay circuit is connected to a gate circuit 116 which in turn is connected to each of the pickup heads 94 by individual leads 118. The delay is for a sufficient time to allow each individually scanned character from the paper copy to be recorded on the tape and reach a position directly under the pickup heads. At this instant, the pickup heads are energized by the gate circuit to receive the identifying code for the particular letter and transmit it to utilization apparatus. The utilization apparatus may be of the type described in U. S. Patent 2,000,403 to Maul, or any other type which operates responsive to signals represented by coded characters. For example, the apparatus shown in Fig. 7 of Maul can be

adapted to operate an automatic tabulating machine from the character code of this invention.

While a particular output apparatus has been described, it is understood that any suitable apparatus capable of scanning subsequent pulse identification, and utilization of the encoded characters may be used with this invention.

If storage of the information is desired, the magnetic tape 90 is run at relatively low speed as the scansion takes place, to pack the information. Packing the information in this manner merely places the code spots closer together, thereby requiring much less storage space. In the event this alternative is used, the magnetic tape 90 is fed to a takeup reel (not shown) for storage instead of being a continuous strip as used for the immediate reading output apparatus described above. Also a fourth recording head (not shown) is positioned at either side or in between the recording heads 88 to record the synchronized gating impulses for the reading process to enable the tape to be properly read at a later time.

In some cases, it is desirable to know in advance whether or not the letter is to be capitalized, the "capital" pickup head 96 may be placed in advance of its normal position so as to give advance indication of capitalization, as is shown in Fig. 4. The "line" pickup head, when used, will indicate that the end of a typewritten line has been reached on the original copy. This enables any reproducing equipment to act accordingly.

It is a well known fact that magnetic pickup apparatus does not require a large magnetic area to obtain an effective signal. A relatively small magnetic area within the scanned area of each scanning head is sufficient to give the necessary code signal required for detection. Consequently, less accurate vertical alignment of the characters and scanning apparatus as well as less printing contrast for the printed characters is tolerable. The sole requirement is that the magnetic areas be within detecting distance of the pickup heads which, as previously pointed out, can be made small.

The typewritten copy thus produced may be used for reproducing copies, sending them over telegraph facilities, operating typesetting machines, with business machines, or other functions. In general, this paper copy, which may be the original, may be used to operate any equipment wherein automatic reading of the original typewritten material is desirable or important. This obviously eliminates the manual transfer to the input device of a machine, when needed.

There has been shown and described hereinabove a novel, and inexpensive method and apparatus for simultaneously printing and magnetically encoding characters. Further, the apparatus requires a minimum amount of maintenance and repairs.

What is claimed is:

1. Apparatus for writing a reproducible message containing printed characters, each having areas magnetized in code combinations for each of said characters, comprising a plurality of electromagnets arranged in a preselected configuration, means for individually printing said characters on magnetizable paper, said electromagnets being positioned behind said paper at the area over which said characters are printed, actuating means for said printing means, and selecting means controlled by said actuating means, to energize preselected ones of said electromagnets in accordance with said coded combinations and simultaneously with the printing of said characters.

2. Apparatus for writing a reproducible message containing characters each having areas magnetized in individual code combinations for each of said characters, comprising a plurality of electromagnets placed behind the area over which said characters are printed, means for individually printing said characters on magnetizable paper, actuating means for said printing means, and selecting means controlled by said actuating means to

energize preselected ones of said electromagnets in accordance with said coded combinations and simultaneously with the printing of said characters, whereby the normal printed characters will have magnetized spots in the area of each of said characters, corresponding to the arrangement of the preselected ones of said electromagnets.

3. Apparatus for writing a reproducible message containing printed characters each having areas magnetized in individual code combinations for each of said characters, comprising a plurality of electromagnets placed behind the area over which said characters are printed, means for individually printing said characters on magnetizable paper, and including said electromagnets for simultaneously magnetizing preselected areas of said printed characters in accordance with said code combinations.

4. In apparatus for producing sequentially printed characters each having areas magnetized in individual code combinations for each of said characters, the combination of a type face for each of said characters, printing ink containing magnetizable material, means for individually actuating said type faces to print said characters of said ink, a plurality of electromagnets positioned behind the area over which said characters are printed, and selecting means controlled by said actuating means to energize preselected ones of said electromagnets in accordance with said coded combinations and simultaneously with the printing of said characters, said coded combinations being selected to lie on the outline of the printed characters, whereby the characters impressed on said sheet will appear in sequence on said sheet and each of said characters will have magnetized spots corresponding to said coded combinations.

5. Apparatus for encoding a message comprising movable type, an inked ribbon arranged in the path of movement of said type, the ink in said inked ribbon having magnetizable material incorporated therein, and means for feeding a sheet of non-magnetic material through said apparatus in position to receive the impression of said type through said ribbon, a plurality of electromagnets positioned behind said material at the area over which said characters are printed, and selecting means actuated by said type operating to energize preselected ones of said electromagnets in accordance with said code combinations and simultaneously with the printing of said characters, whereby the normal printed characters will have magnetized spots adjacent each of said characters corresponding to the arrangement of the preselected ones of said electromagnets.

6. Apparatus for encoding a message comprising printing apparatus having movable type, an inked ribbon arranged in the path of movement of said type, means for feeding a sheet of magnetizable material through said apparatus in position to receive the impression of said type through said ribbon, a plurality of electromagnets positioned behind said material at the area over which said characters are printed and arranged in a preselected configuration, actuating means for said type, and selecting means operated by said actuating means for energizing preselected ones of said electromagnets in accordance with a different code combination for each of said type and simultaneously with the printing of said characters, whereby the normal characters of said type will be imprinted on said material, and spots on said material will be magnetized in accordance with the arrangement of preselected ones of said electromagnets.

7. Apparatus for encoding a message comprising printing apparatus having movable type, and an inked ribbon arranged in the path of movement of said type, means for feeding a sheet of magnetizable material through said apparatus in position to receive the impression of said type through said ribbon, a plurality of electromagnets positioned behind said material at the area over which said characters are printed and arranged in a preselected

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configuration, an actuating member for said type, and selecting contacts mounted on and operated by said actuated means for simultaneously energizing preselected ones of said electromagnets in accordance with a code combination for each of said type, the normal characters of said type being imprinted on said material, and at the same time spots on said material being magnetized in accordance with the arrangement of preselected ones of said electromagnets.

8. Apparatus for encoding a message comprising movable type, and an inked ribbon arranged in the path of movement of said type, the ink in said ribbon having magnetizable material incorporated therein and means for feeding a sheet of nonmagnetic material through said apparatus in position to receive the impression of said type through said ribbon, a plurality of electromagnets positioned behind said material at the area over which said characters are printed, actuating members for said type, and selecting contacts mounted on and operated by said actuating members for said type for simultaneously energizing preselected ones of said electromagnets in accordance with a code combination for each of said type, the normal character of said type being imprinted on said material and spots being magnetized in the areas of each

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of said characters corresponding to the arrangement of the preselected ones of said electromagnets.

9. In apparatus for producing printed characters having associated areas magnetized in individual code combinations for each of said characters, the combination of a plurality of electromagnets arranged in a preselected configuration, means for rendering magnetizable the areas in which said characters are printed, means for printing said characters, and means including said electromagnets for magnetizing preselected areas of said printed characters in accordance with said code combinations and at the same time as the printing of said characters.

References Cited in the file of this patent

UNITED STATES PATENTS

2,067,183	Green	Jan. 12, 1937
2,183,559	Green	Dec. 19, 1939
2,258,106	Bryce	Oct. 19, 1941
2,359,617	Bryce	Oct. 3, 1944
2,540,287	Potts	Feb. 6, 1951
2,558,187	Marrison	June 26, 1951
2,567,812	Hickman	Sept. 11, 1951
2,614,169	Cohen et al.	Oct. 14, 1952