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[54] **METHOD OF ENCODING DATA ON PRINTED RECORD MEDIA**
11 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **101/426,** 197/1
[51] **Int. Cl.** **B41m 3/00**
[50] **Field of Search** 197/1; 340/146.3; 101/426; 283/66, 55, 60

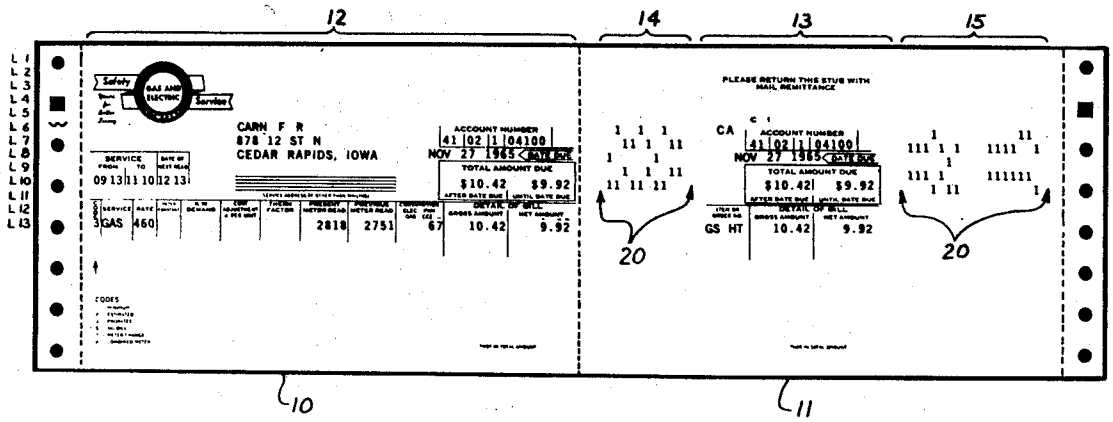
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ABSTRACT: A method of encoding data on printed documents or other record media to be processed by automatic data processing equipment. The method comprises printing conventional printing characters on the document with conventional character spacing in a legible uncoded format on selected printing lines on the document, such as by the use of a conventional high speed computer printer. The uncoded printing format provides at least one clear area of at least five printing lines and including at least one of the lines on which the characters are printed in the uncoded format. Simultaneously with the printing of the characters in the uncoded format, a selected conventional printing character is printed in an illegible coded format in said clear area with the same conventional character spacing and on at least one of the same printing lines as the characters in the uncoded format.



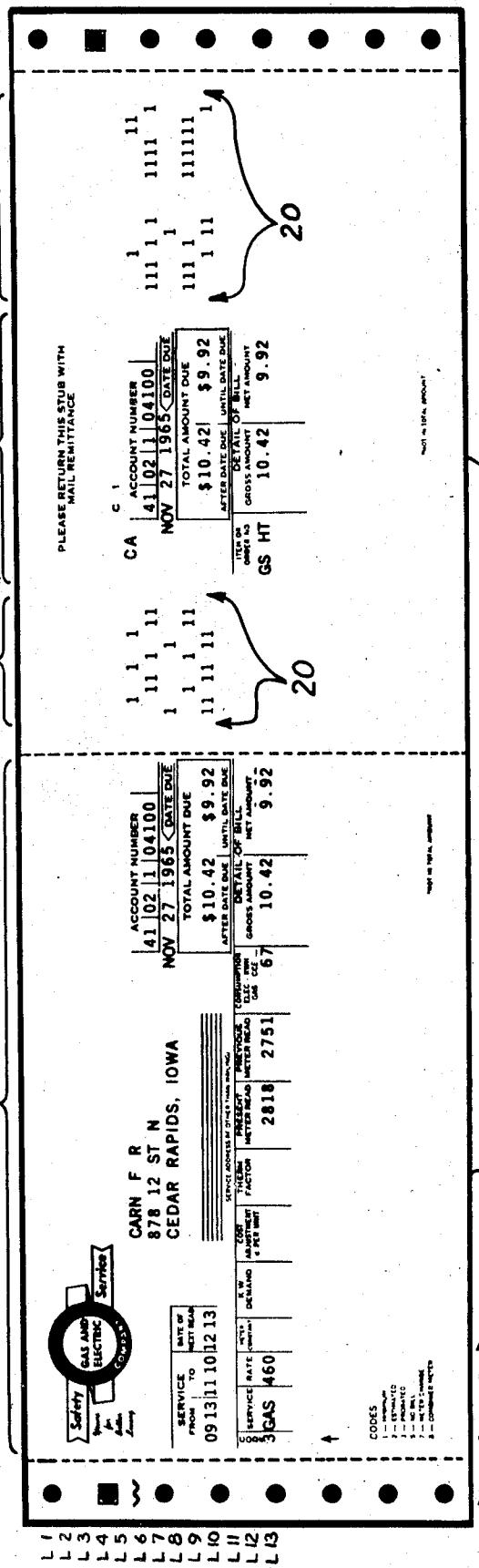
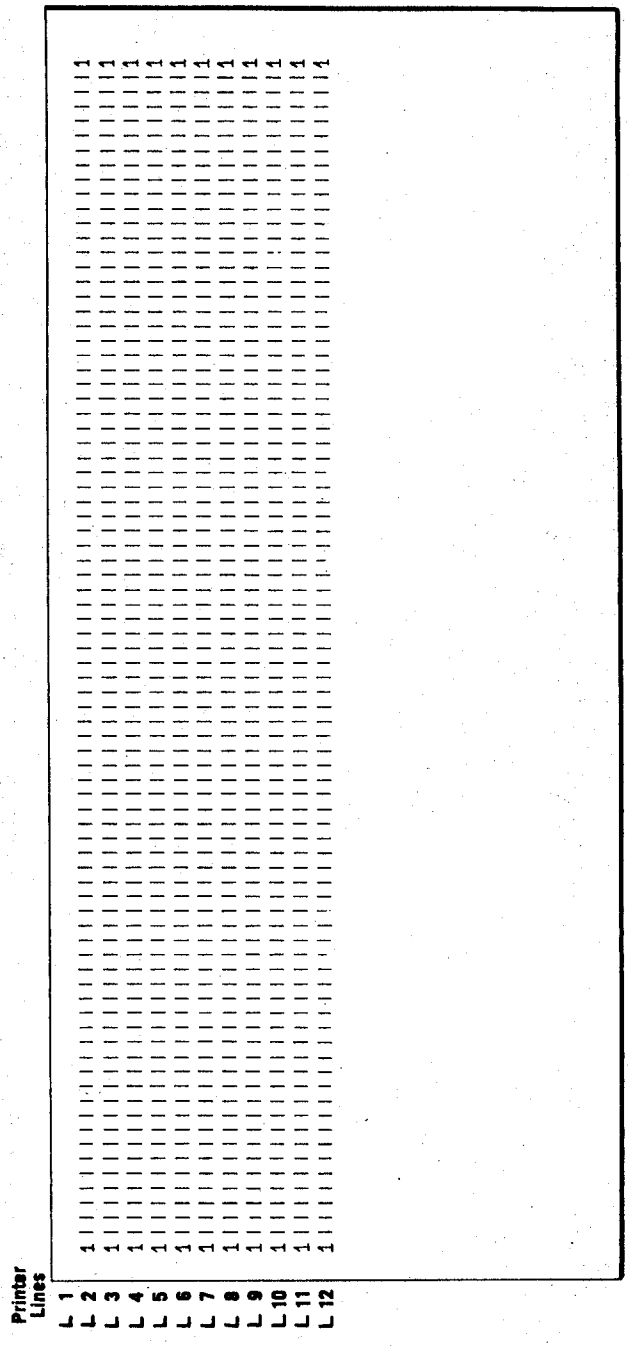


FIG. 1

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FIG. 2



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METHOD OF ENCODING DATA ON PRINTED RECORD MEDIA

The present invention relates generally to the printing of documents to be processed by automatic data processing equipment and, more particularly, to the encoding of data on printed documents to be processed by automatic data processing equipment having automatic coded character reading means.

Heretofore, a number of different codes have been developed for representing alphabetical and numerical characters in coded form on different types of record media in order to facilitate the handling of such media, and the data thereon, in automatic data processing equipment. For example, a few of the codes which enjoy relatively wide use today are the various bar codes, the marked codes, the perforated readable or readable reverse codes, and the perforated in-line code. The equipment for processing the data represented by these codes normally includes an automatic reading device which responds to the various code indicia to generate electrical signals representing the encoded data, and suitable for application to appropriate computing devices. Various pieces of auxiliary equipment, such as sorters, recorders, accumulators and the like may also be tied in to the automatic reading device and, in addition, special encoding equipment is required for applying the code indicia to the record media.

The primary object of the present invention is to provide an improved method of representing characters in coded form on record media without the use of any special encoding equipment. A related object of the invention is to provide such a method which enables data to be encoded on printed record media simultaneously with the printing of uncoded information thereon and with the same equipment, such as a high speed computer printer.

It is another object of this invention to provide an improved method of encoding data on printed record media more rapidly than encoding methods used heretofore.

A further object of the invention is to provide an improved method of encoding data on printed record media with code indicia which can be read by conventional photoelectric sensing elements.

Other objects and advantages of the invention will become apparent as the following description proceeds, taken in conjunction with the accompanying drawings, in which:

FIG. **1** is an illustration of a typical business document having uncoded information printed thereon along with coded characters printed in accordance with the method of the invention; and

FIG. **2** is a template for use in laying out the format of a business document to be printed by the method of this invention.

While the invention has been shown and will be described in some detail with reference to a particular embodiment thereof, there is no intention that it thus be limited to such detail. On the contrary, it is intended here to cover all alternatives, modifications and equivalents falling within the spirit and scope of the invention as defined by the appended claims.

Referring now to FIG. **1**, a typical business document is illustrated in the form of a bill **10** and attached remittance stub **11**. The billing company sends the entire document to the customer, who then detaches the remittance stub **11** and returns it to the billing company along with his remittance. A bill of this type is conventionally prepared by printing informational data in a legible uncoded format in a field **12** on the bill **10** and field **13** on the remittance stub **11**. The printing is normally effected by a high speed computer printer which prints conventional printing characters with conventional character spacing on selected printing lines in the two fields **12** and **13**. In the particular example illustrated, the characters are printed on the same lines in both printing fields **12** and **13**, namely lines **L6**, **L7**, **L8**, **L10**, and **L13**. The vertical spacing of the printing lines is six lines to the inch, the column spacing is 0.100 inch center-to-center, and each printed character is 0.100 inch high, all of which are conventional dimensions for characters printed by a high speed computer printer.

Although these specific dimensions are standard for most computer printers today, it will be appreciated that such dimensions may be changed in the future, and the present invention is not restricted to any particular dimensional limits.

In a document of the type illustrated in FIG. **1**, the legible uncoded printing format is usually designed to provide one or more clear areas for the printing of code indicia in an illegible coded format. As used herein, the term "clear area" refers to an area which does not contain any printed matter that can be sensed by the reading means, *e.g.* photocells, although printed matter that cannot be seen by the reading means may be present in such areas. Thus, the printing format in the fields **12** and **13** is designed to provide clear areas for code fields **14** and **15** extending continuously across all the printing lines used in the uncoded printing format, on the remittance stub **11**. Consequently, when the billing stub **11** is returned to the billing company along with the customer's remittance, the stub **11** and the data thereon can be automatically processed by appropriate data processing equipment.

In accordance with the present invention, data is encoded on the printed document simultaneously with the printing of the characters in the legible uncoded format, by printing a selected conventional printing character in an illegible coded format in the code fields with the same conventional spacing and on one or more of the same printing lines as the characters in the uncoded format. Thus, the code indicia are formed by a conventional printing character, such as a "**1**" for example, which is printed repetitively in a code pattern, but with the same spacing as the uncoded characters.

Referring again to FIG. **1**, informational data is encoded in the fields **14** and **15** by the repetitive printing of the conventional printing character "**1**" in an illegible coded format comprising five adjacent printing lines **L6** through **L10**. Four of the printing lines in the coded printing format, namely lines **L6**, **L7**, **L8**, and **L10**, are common to the uncoded format in fields **12** and **13**. The fifth printing line for the coded format, namely line **L9**, is used only for the printing in the code fields **14** and **15**, *i.e.*, no printing occurs on line **L9** in the uncoded fields **12** and **13**. As will be apparent to those skilled in the art, the printed "**1**"'s located in the top four lines of each vertical column in the code fields **14** and **15** represent a particular character in a conventional binary code. More particularly, the top four printed lines in each code field represent the values 1, 2, 4, and 8. The fifth printing line at the bottom of each code field is used for parity checking purposes in accordance with the conventional "even parity" binary code, so that each character of the encoded data is represented by eight either two or four "**1**"'s in a vertical column. The particular combinations of "**1**"'s for representing the ten digits 0 through 9 in the even parity binary code utilized in the illustrative example are shown in the following table:

	Digits									
Value	1	2	3	4	5	6	7	8	9	0
1	1		1		1		1		1	
2		1	1			1	1			1
4				1	1	1	1			
8								1	1	1
P	1	1		1			1	1		

Thus, in the particular example illustrated in FIG. **1**, the number represented in code field **14** is 4102104100, and the numbers represented in code field **15** are 0001042 and 0000992. Of course, the number of digits represented in any given field depends on the number of vertical columns of "**1**"s in that field. It will be appreciated that any number *n* of "**1**"'s may be repetitively printed on any given printing line in a code field, depending on the number of vertical columns in that particular field and the particular numbers represented in each column. For example, in the particular document illustrated in FIG. **1**, the number *n* of "**1**"'s in the five printing lines

of field **14** varies from two to six, while in field **15** *n* varies from one to ten.

In order to permit the use of only a single printing character in the code fields, such as the character "**1**" in the illustrative example, it is preferred to use a binary type code so that any numerical character can be represented by the mere presence or absence of the selected character at the five selected printing lines in each column of the code field. However, it will be appreciated that binary codes other than the particular species illustrated, such as an odd parity binary code for example, can be used in the method of this invention.

In keeping with the present invention, the repetitive "**1**"'s in the code fields **14** and **15** are printed simultaneously with the characters in the uncoded fields **12** and **13**, and by the same printing equipment or joint. Aside from the illegible coded format in the code fields **14** and **15**, the printing of the characters in these fields is conventional, so that no special encoding equipment is required. That is, the center-to-center spacing of successive characters in the code fields **14** and **15** is the conventional 0.100 inch, the center-to-center spacing of adjacent printing lines is the conventional 0.166 inch, and the height of the characters is the conventional 0.100 inch, so that the coded and uncoded characters can be printed in a single printing operation. Thus, in the printing of line **L6** of the illustrative document, the customer's name and account number in field **12**, the top row of three "**1**"'s in field **14**, the abbreviation "-CA" in field **13**, and the top row of three "**1**"'s in field **15** are all printed in a single pass of the printing means for example, when the printing means is a conventional drum type printer, both the "CA" in the uncoded field and the "**1**"'s on the same printing line in the coded fields are printed in a single revolution of the drum, or in the case of a chain type printer all the characters on the same printing line are printed in a single revolution of the chain. The printing of all the other lines is effected in a similar manner. In the case of line **L9**, no printed characters appear in the uncoded fields **12** and **13**, so the only characters printed on this line are those appearing in the code fields **14** and **15**, but the printing of these characters is still effected in the normal printing sequence as the printing means progresses from line **L8** to line **L9** and then on to line **L10**. Similarly, in printing line **L13** there are no characters in the code fields **14** and **15**, so the only characters printed on this line are those appearing in the uncoded fields **12** and **13**, which again are printed in the normal printing sequence. In other words, the entire document, including all the fields **12** through **15**, is printed in a single printing operation without the use of any special encoding equipment whatever.

It will be apparent that the only restrictions on the location of the characters in the code format within any given code field, are the restrictions imposed by the particular reading system to be used to read the encoded data. In copending U.S. Pat. application Ser. No. 687,883, entitled Automatic Reading System for Record Media Having Encoded Data filed Dec. 4, 1967 and assigned to a common assignee, there is described a reading system that is capable of reading a code of the type illustrated in FIG. **1** in any of eleven different printing lines, provided the same lines are used throughout any one document format. A template for use in laying out the code fields on a document to be read by the reading system described in the aforesaid copending application is shown in FIG. **2** for the purpose of demonstrating the flexibility of the encoding method of this invention. Thus, as indicated on the template, the characters in any prescribed code field can be printed in any five of eleven different printing lines **L2** through **L12**. With this system the characters in the code fields need not be printed on five adjacent lines, as illustrated in FIG. **1**, but can be printed on lines spaced apart by one or more lines. Consequently, a faster print out can frequently be obtained by selecting the same printing lines for the characters to be printed in both the coded and uncoded fields. For example, in the document illustrated in FIG. **1**, four of the five printing lines **L6** through **L10** in the code fields **14** and **15** are also utilized for the printing of characters in the uncoded fields **12** and **13**. The fifth printing line in the uncoded fields, namely line **L13**, could not be utilized in the code file fields because the document format was designed according to the template in FIG. **2**, which does not permit the use of printing line **L13** in the code fields. If the reading ability of the automatic reading system were increased by one printing line, however, line **L13** would then be available, and the characters in the code fields **14** and **15** could be printed on the same five lines used in the uncoded fields, namely lines **L6**, **L7**, **L8**, **L10**, and **L13**.

While it is preferred to print the characters in the coded fields with a minimum spacing, *i.e.*, ten characters to the inch, in order to provide the maximum data density in each code field, it will be understood that the character spacing can be increased in increments of 0.100 inch if desired. In this case, the printer would simply skip one or more character spaces between character printings in any given line, but the overall spacing of the characters printed in the code field would still be conventional, and thus compatible with the normal printing means.

It should also be noted that conventional printing characters other than "**1**" can be used as the code indicia in the coded format printed by the method of this invention. It is preferred to use a substantially linear character without any discontinuities, such as "L", "7", "T", "t", and "I". Also, both "i" and "!" have been used with success, even though they have minor discontinuities. In selecting the particular character to be used in any given system, the important criterion is that the selected character be capable of being reliably detected by the particular reading means used in the system. In actual practice, it has been found that the "**1**" can be detected with a high degree of reliability by a photoelectric reading head utilizing photosensitive elements of the variable resistance type, such as that described in copending U.S. Pat. application Ser. No. 687,883 mentioned previously.

For the purpose of insuring against spurious readings of the data encoded in the fields **14** and **15**, it is preferred to have each code field separated from all adjacent fields by a blank guard band of appropriate width, *e.g.* 0.300 inch wide, as illustrated at **20** in FIG. **1**. This prevents the automatic reading device from generating erroneous output signals in the event that the enabling of the reading device is not precisely synchronized with the limits of the particular code field being read, and also permits greater tolerances in the original printing of the document and subsequent coding thereof. The guard band can be reduced at the leading edge of the document when a code field is the first field on the document, but the standard guard band should normally be maintained at the trailing edge of the document.

Since the code indicia provided by the method of this invention are necessarily in printed form, automatic reading of the encoded data may be accomplished by the use of photoelectric reading means including a light source for directing light onto the code fields, and an array of conventional photosensitive elements for receiving the light reflected from the indicia locations in the code field, and thereby sensing whether the indicia are present or absent at each location. Output signals generated by the photosensitive elements then provide an electrical representation of the encoded data suitable for application to appropriate computing devices and the like. For those interested in a more detailed understanding of such a reading system, reference may be had to aforesaid copending application.

As can be seen from the foregoing detailed description, this invention provides an improved method of representing characters in coded form on record media without the use of any special coding equipment whatever. This method enables data to be encoded on printed record media simultaneously with the printing of legible informational data thereon, and with the same equipment, such as a high speed computer printer. Since the characters in the code fields and the uncoded fields may be printed on the same printing lines, a more rapid print out may be achieved. Furthermore, the code indicia provided by this method are in printed form so that they can be read by conventional photosensitive reading elements.

It will be understood that the term "illegible" as used herein refers to a format of characters which cannot be read or understood by a layman who is not familiar with binary codes. Obviously a person who is familiar with binary codes could read the numbers represented in binary form in fields **14** and **15** in FIG. 1, for example, but the format of the characters in those fields is still "illegible" in accordance with the meaning of that term as used herein.

We claim:

1. A method of printing record media with encoded data to be processed by automatic data processing equipment, said method comprising the steps of printing conventional printing characters with conventional printing elements available in the normal printing font of a selected conventional printing means, the printed characters having conventional character and line spacing in a legible uncoded format on selected printing lines on the record medium, said uncoded printing format providing at least one clear area comprising at least five printing lines including at least one of the lines on which characters are printed in said uncoded format, said five printing lines being provided to accommodate the data bits required for a conventional five-level binary code, and printing a selected conventional printing character in a coded format in said clear area with one of the conventional printing elements in the normal printing font of the same printing means used to print the characters in said uncoded format and with the same conventional character and line spacing and on at least one of the same printing lines as the characters in said uncoded format, the characters in said coded format and in said uncoded format all being printed in the same single pass of the printing means whenever said characters are printed on a common printing line in both the coded and uncoded formats are printed in a single printing operation using only the conventional printing elements in the normal font of the printing means without requiring any auxiliary printing or encoding equipment.

2. A method of printing record media as defined in claim **1** in which said coded format is in the form of a binary code.

3. A method of printing record media as defined in claim **1** in which said selected conventional printing character printed in said coded format is a conventional printed "**1**".

4. A method of printing record media with encoded data to be processed by automatic data processing equipment, said method comprising the steps of printing conventional printing characters with conventional printing elements available in the normal printing font of a selected conventional printing means, the printed characters having conventional character and line spacing in a legible uncoded format on selected printing lines and in selected fields on the record medium, said selected fields being spaced to provide at least one clear area extending across at least five printing lines including one or more of the lines on which said characters are printed in said legible uncoded format in said selected fields, said five printing lines being provided to accommodate the data bits required for a conventional five-level binary code, and printing a selected conventional printing character in a coded format in said clear area with one of the conventional printing elements in the normal printing font of the same printing means used to print the characters in said uncoded format, said character in said coded format being printed with the same conventional character and line spacing on one or more of the same printing lines as the characters in said uncoded format in said selected fields, the characters in said coded format and in said uncoded format all being printed in the same single pass of the printing means whenever said characters are printed on a common printing line in both the coded and uncoded formats, whereby the characters in both the coded and uncoded formats are printed in a single printing operation using only the conventional printing elements in the normal font of the printing means without requiring any auxiliary printing or encoding equipment.

5. A method of printing record media with encoded data to be processed by automatic data processing equipment, said method comprising the steps of printing conventional printing characters having a height of 0.100 inch with conventional printing elements available in the normal printing font of a selected conventional printing means, the printed characters having conventional character spacing of 0.100 inch center-to-center in a legible uncoded format on selected printing lines spaced equally six lines to the inch, said uncoded format providing at least one area of at least five printing lines for the application of printed code indicia, said five printing lines being provided to accommodate the data bits required for a conventional five-level binary code, at least one of the printing lines in said area having characters printed thereon in said uncoded format, and printing a single conventional printing character having a height of 0.100 inch repetitively in a coded format in said area with one of the conventional printing elements in the normal printing font of the same printing means used to print the characters in said uncoded format and with conventional character spacing of 0.100 inch center-to-center and on at least one of the same printing lines as the characters in said uncoded format, the printing lines in said coded format being equally spaced six lines to the inch, the characters in said coded format and in said uncoded format all being printed in the same single pass of the printing means whenever said characters are printed on a common printing line in both the coded and uncoded formats, whereby the characters in both the coded and uncoded formats are printed in a single printing operation using only the conventional printing elements in the normal font of the printing means without requiring any auxiliary printing or encoding equipment.

6. A method of printing record media with encoded data to be processed by automatic data processing equipment, said method comprising printing in a single pass of selected conventional printing means (1) legible uncoded data comprising conventional printing characters available in the normal printing font of said printing means with conventional character and line spacing, said uncoded data being printed in selected uncoded printing fields that are spaced to provide coded printing fields, and (2) coded data comprising a selected conventional printing character available in the normal printing font of said printing means and appearing repetitively in said coded printing fields with the same conventional character and line spacing as the characters in said legible uncoded format, whereby the characters representing both the coded and uncoded data are printed in a single printing operation using only the conventional printing elements in the normal printing font of said printing means without requiring any auxiliary printing or encoding equipment.

7. A method of printing record media as defined in claim **6** in which said characters in said coded format are printed in the form of a binary code.

8 A method of printing record media as defined in claim **6** in which the characters in said coded format are printed on at least one of the same printing lines as the characters in said legible uncoded format.

9. A method of printing record media as define in claim **6** in which said selected conventional printing character printed in said coded format is a conventional printed "**1**".

10. A method of printing record media with encoded data to be processed by automatic data processing equipment, said method comprising the steps of utilizing available in the normal printing font of a selected conventional printing means to print conventional printing characters with conventional character and line spacing in a legible uncoded format on selected printing lines on the record medium, said uncoded printing format providing at least one clear area comprising at least five printing lines including at least one of the lines on which characters are printing lines including at least one of the lines on which characters are printed in said uncoded format, and utilizing a selected conventional printing element available in the normal printing font of said selected conventional printing means to print a selected conventional printing character in a coded format in said clear area with the same conventional character and line spacing and on at least one of the same printing lines as the characters in said uncoded for-

mat, the characters in said coded format and in said uncoded format all being printed in the same single pass of the printing means whenever said characters are printed on a common printing line in both the coded and uncoded formats, whereby the characters in both the coded and uncoded formats are printed in a single printing operation using only the conventional printing elements in the normal font of the printing means without requiring any auxiliary printing or encoding equipment.

11. A method of printing record media with encoded data to be processed by automatic data processing equipment, said method comprising the steps of printing conventional printing characters with conventional printing elements available in the normal printing font of a selected conventional printing means, the printed characters having conventional character and line spacing in a legible uncoded format on selected printing lines on the record medium, said uncoded printing format providing at least one clear area comprising at least five printing lines including at least one of the lines on which characters are printed in said uncoded format, and printing a selected conventional printing character repetitively *n* times on each of five different printing lines in said clear area with one of the conventional printing elements in the normal printing font of the same printing means used to print the characters in said uncoded format and to form a coded format, said selected character in said coded format being printed with the same conventional character and line spacing and on one or more of the same printing lines as the characters in said uncoded format the characters in said coded format and in said uncoded format all being printed in the same single pass of the printing means whenever said characters are printed on a common printing line in both the coded and uncoded formats, whereby the characters in both the coded and uncoded formats are printed in a single printing operation using only the conventional printing elements in the normal font of the printing means without requiring any auxiliary printing or encoding equipment.