Dec. 2, 1969 G. BURKHARDT ET AL 3,481,446

RIBBON FEEDING ARRANGEMENT FOR N-DIGIT CODE IMPRINTS

Filed Oct. 10, 1967 4 Sheets-Sheet 1

Fig.1

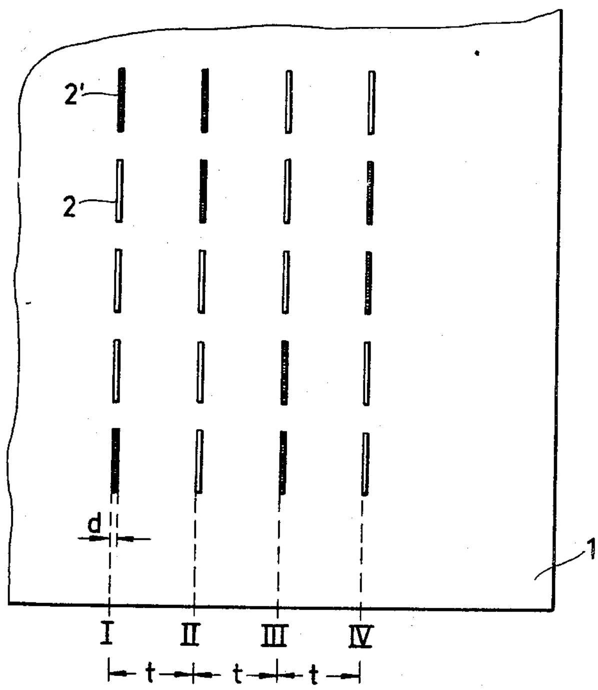
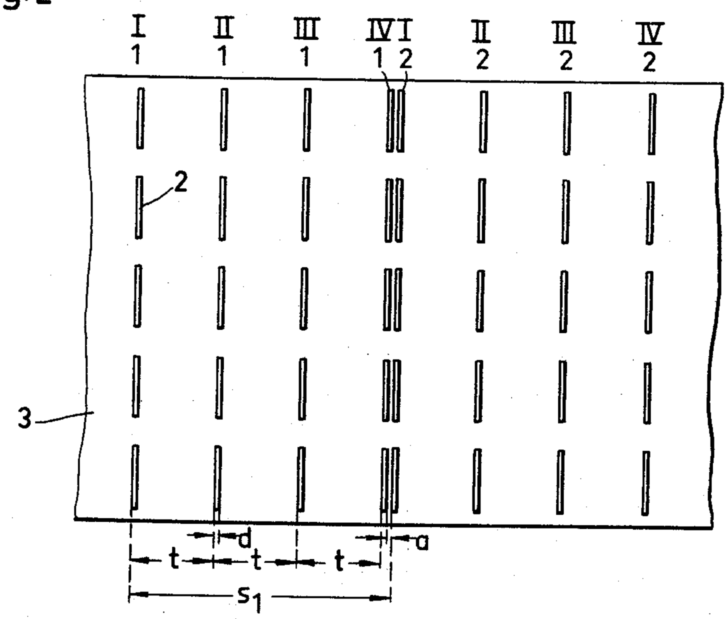


Fig. 2



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Filed Oct. 10, 1967 4 Sheets-Sheet 2

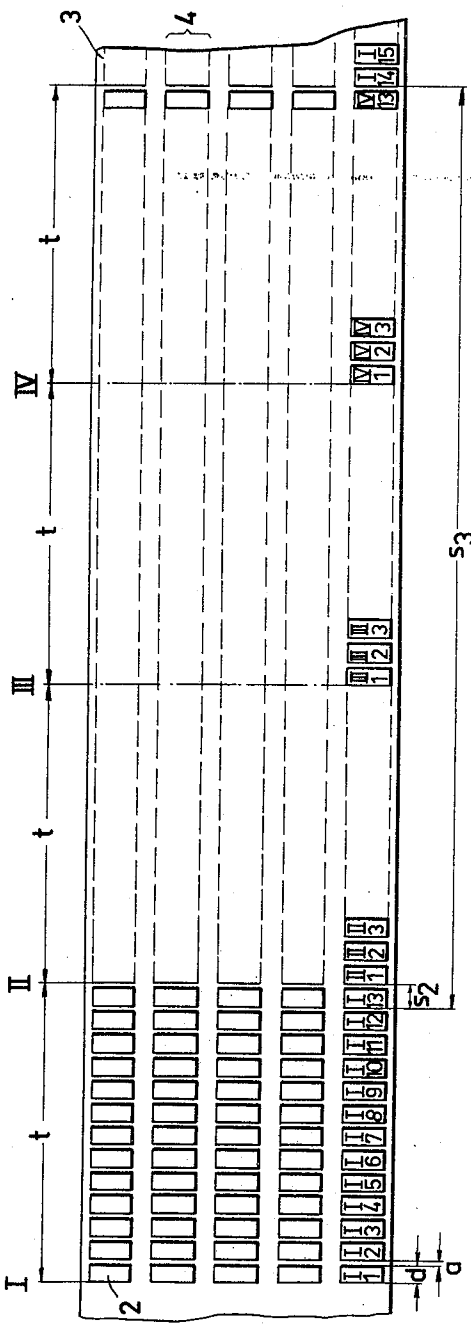

Fig. 3

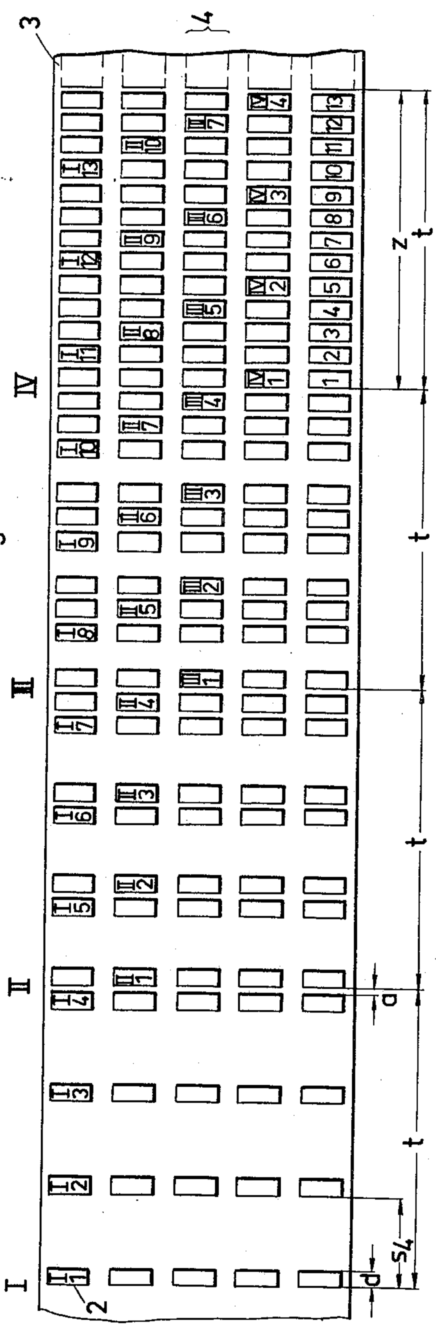

Fig.4

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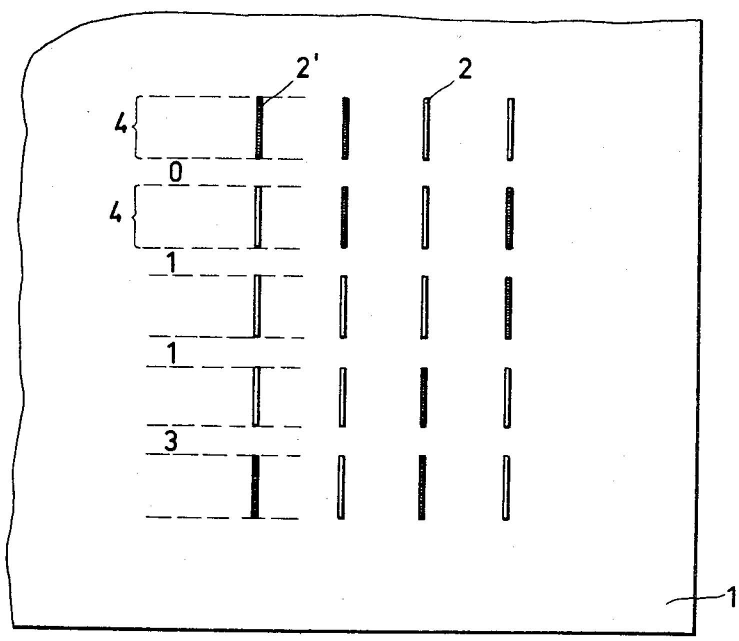
Fig. 5



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RIBBON FEEDING ARRANGEMENT FOR N-DIGIT CODE IMPRINTS

Filed Oct. 10, 1967 4 Sheets-Sheet 4

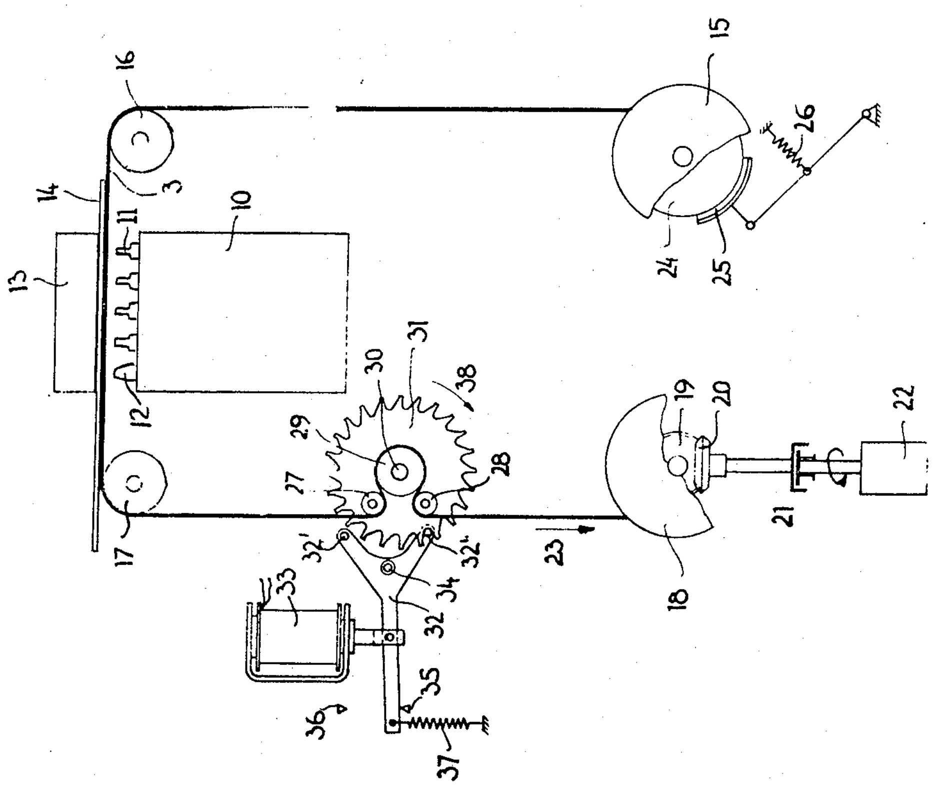

FIG. 6

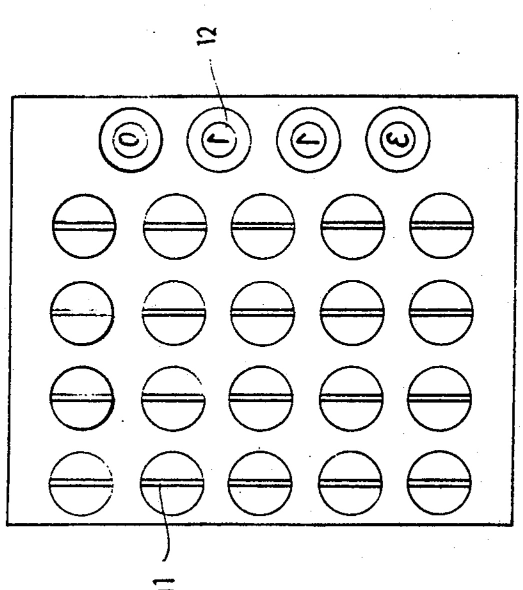

FIG. 7

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1

3,481,446

RIBBON FEEDING ARRANGEMENT FOR N-DIGIT CODE IMPRINTS

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Int. Cl. B41j 33/14
U.S. Cl. 197—151 3 Claims

ABSTRACT OF THE DISCLOSURE

A printing arrangement for n-digit (n-column) code imprints with uniform spacing between the code elements and using an inked ribbon (transfer ribbon) which is advanced in steps of equal size after each printing operation in the direction of the printed line by one step so that for the next printing operation all types will be opposite an unused portion of the ribbon.

BACKGROUND OF THE INVENTION

The present invention relates generally to printing mechanisms and, more particularly, to such devices for n-digit, or n-column code imprints with uniform spacing between the code elements and using an inked ribbon which, after each printing operation, is advanced by one step in the direction of the line to be printed to a point where all printing types face an unused part of the ribbon for the subsequent printing operation.

Such printing mechanisms are particularly needed for the application of coded routing information onto shipments which are to be sorted by machine, particularly mail shipments. For this purpose ribbons are used which are heat-printing foils whose color is completely transferred to the surface to be printed when pressed thereon.

FIGURE 1 shows the lower right-hand corner of a mail shipment **1** which is provided with a code imprint serving as a routing indicator, for example, for automatic mail sorting mechanisms. The twenty possible positions **2** of the code elements **2'** are arranged in five lines and in four columns. Each one of the columns I, II, III and IV represents the numbers 0 to 9 according to a 2-out-of-5 code so that a four-digit number is represented by the code imprint. Accordingly, the printing mechanism is provided with five printing types in each one of the four columns of which only two are used for printing at any one time.

Based on the requirement that during each printing process it must be assured that all printing types face an unused portion of the ribbon, the ribbon could be advanced after each printing operation by one step, the length s_1 of which corresponds approximately to the width of the code field. FIGURE 2 refers to this procedure and shows a ribbon **3** which has been advanced by such a step and the impressions of two code imprints. In the interest of a more legible representation of the essential elements, all possible positions **2** of the code elements (**2'**) are drawn here, as well as in FIGURES 3 and 4, without particularly emphasizing the two code elements **2'** of each column which were actually printed.

To assure that, in spite of certain inaccuracies in the ribbon transport, a printing type cannot even partially

2

fall onto a used portion of the ribbon, a minimum distance a_{min} must be provided on the ribbon between two adjacent spots to be printed. When the width of the code elements **2'** is d, the number of digits in a printed line is n and the spacing between two adjacent code elements, center to center, is t, a procedure according to FIGURE 2 would result in the value

$$s_1=(n-1)\cdot t+d+a_{min} \quad (1)$$

for the length of a transporting step s_1.

For reasons of comparison, the following values derived from actual use are assumed:

Spacing between two adjacent code elements	t=8 mm.
Number of positions (columns) in the printing mechanism	n=4.
Width of a code element	d=0.5 mm.
Distance between two adjacent used portions on the ribbon	a.
Minimum distance	a_{min}=0.1 mm.

Employing Equation 1, the following step length results:

$$s_1=(4-1)\cdot 8+0.5+0.1=24.6 \text{ mm.}$$

The disadvantage of a ribbon transport according to FIGURE 2 therefore lies in the great amount of ribbon used for each imprint, i.e., 24.6 mm.

A further disadvantage results from the amount of time required for the transport of the ribbon, i.e., at a ribbon speed of e.g., 5 cm./sec., approximately 0.49 sec. With a desired printing sequence of 5000 imprints per hour, corresponding to a cycle time of 0.72 sec. per imprint, the ribbon transport alone would require 68% of the cycle time whereas only 32% (0.23 sec.) would be available for the printing process itself—positioning of the shipment against the support, printing and removal of the support.

The amount of ribbon consumed can be considerably reduced when, according to an already known procedure, the ribbon is advanced each time, as shown in FIGURE 3, in small steps which are adjusted to the width d of one code element:

$$s_2=d+a \quad (2)$$

In FIGURE 3 the longitudinal scale is considerably extended when compared with FIGURE 2. For the same reasons, only the positions **2** of the thirteen first imprints of the five printing types of the first column I are completely shown whereas only a few of the remaining positions are shown within the individual line tracks **4**. The Roman numerals indicate the respective column of the printing mechanism, and the Arabic numerals the number of printing operations. I1 thus indicates the first printing of the first digit, II3 the third printing of the second digit, IV13 the thirteen printing of the fourth digit. This information is entered only in the fifth line, i.e., in the lowermost one of the five tracks **4**, but pertains each time to all imprints in the corresponding column. When after a number of

$$z\leqq t/s_2$$

small steps a printing type could come opposite a used portion of the ribbon, a larger step is made of length

s_3, as in the procedure according to FIGURE 2, to again correspond to the width of the code field:

$$s_3=(n-1)\cdot t+d+a \quad (3)$$

$$=(n-1)\cdot t+s_2 \quad (3a)$$

With equal distribution of the imprints within the space *t*, the following relationship applies:

$$s_2=d+a=t/z \quad (2a)$$

and thus

$$a=t/z-d=s_2-d$$

With the above-mentioned exemplary values, the following number z of imprints to be accommodated with the space t results:

$$z\leqq t/(d+a_{\min}) \quad (4)$$

$$a\leqq 8/(0.5+0.1)=13.3$$

and thus the maximum number of $z=13$ imprints. Therefore,

$$s_2=t/z=8/13=0.616 \text{ mm.}$$

$$a=s_2-d=0.616-0.5=0.116 \text{ mm.}$$

and

$$s_3=(4-1)\cdot 8+0.616=24+0.616=24.616 \text{ mm.}$$

Considering that for z imprints $z-1$ small steps s_2 and one large step s_3 are required, the following results for the consumption of ribbon f per printing operation:

$$f=[(z-1)\cdot s_2+1\cdot s_3]/z$$

and using Equations $2a$ and $3a$

$$f=n\cdot s_2$$

with the numerical Example 5

$$f=4\cdot 0.616=2.46 \text{ mm.}$$

The consumption of ribbon therefore, in comparison with the step sequence according to FIGURE 2 is only 10%.

Since, howover, the amount of time required for the larger step s_1—0.49 sec. as above—must be programmed into every printing cycle, here too only 32% of the cycle time is available for the printing process itself.

SUMMARY OF THE INVENTION

With this in mind, it is the object of the present invention to avoid these disadvantages of the prior art.

Another object is to provide a printing arrangement for the above-mentioned purposes with which not only the smallest possible ribbon consumption is realized but wherein the time to be programmed into the printing cycle for the ribbon transport—at uniform ribbon speed—is considerably reduced.

These objects and others ancillary thereto are accomplished in accordance with preferred embodiments of the present invention wherein the ribbon transporting device is arranged so that the ribbon is always moved in equally sized steps of a length of

$$s=n\cdot t/z \quad (6)$$

wherein the number z of the ribbon imprints to be made within the space t and the number n of the columns must not have any common divisor and wherein

$$z\leqq t/(d+a_{\min}) \quad (4)$$

BRIEF DESCRIPTION OF THE DRAWING

FIGURE 1 is a diagrammatic view of a code imprint on a mail shipment in the approximate scale of 2:1.

FIGURE 2 is a diagrammatic view of a ribbon with imprints according to a first possible sequence of steps for the movement of the ribbon, using the same scale.

FIGURE 3 is a diagrammatic view of a ribbon with imprints according to a second known sequence of steps for the movement of the ribbon at a scale which is, extended in length when compared with FIGURE 2.

FIGURE 4 is a diagrammatic view of a ribbon with imprints corresponding to the printing mechanism according to the present invention and using the same scale as FIGURE 3.

FIGURE 5 is a diagrammatic view of a code imprint on a mail shipment including an identifying mark according to a further embodiment of the present invention.

FIGURE 6 is a diagrammatic view of a printing device according to the present invention.

FIGURE 7 is a diagrammatic front view of the printing types used in the printing device of FIGURE 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGURE 4 clearly illustrates the intermeshing of consecutive imprints of the different columns. This figure corresponds to FIGURE 3 with respect to the longitudinal and latitudinal scale. The meaning of the Roman and Arabic numerals is also identical. Within a length of ribbon of **4*t*** all imprints are illustrated which occur during the process of the first 13 printing operations. For reasons of clarity, the imprints of the first column (**I1**, **I2**, etc) are numbered only in the first line (first track **4**), the imprints of the second column only in the second line, etc. In the right-hand portion of the fifth line the imprints which fall within one space t are consecutively numbered without regard to the sequence of their formation.

In the procedure according to the present invention, the maximum number z of the ribbon imprints to be accommodated within the space t can therefore also be selected according to the equation

$$z\leqq t/(d+a_{\min}) \quad (4)$$

as long as the resulting maximum whole number meets the requirement that it has no common divisor with the number n of columns. Using the same numerical values as above $x_{\max}=12$ results. Since this number has no common divisor with $n=4$, $z=13$ can be selected. Thus it results that

$$s_4=n\cdot t/z=4.8/13=2.46 \text{ mm.}$$

and

$$a=t/z-d=8/13-0.5=0.116 \text{ m.}$$

The consumption of ribbon f per printing operation in the printing mechanism according to the present invention is

$$f=s_4 \quad (7)$$

in a numerical example:

$$f=2.46 \text{ mm.}$$

and is therefore the same as in the procedure discussed in connection with FIGURE 3. Of course these considerations relate to the continuous operation of the printing device whereas FIG. 4 relates to the position of imprints during the initial phase of operation, that is during the first 13 steps of movement of the ribbon.

The time to be programmed into each printing cycle for ribbon transport, however, has been considerably reduced since only steps of 2.46 mm. in length are being made. At the same ribbon speed as in the previous examples this time is only approximately 0.05 sec. Therefore, only 7% of the desired cycle time of 0.72 sec. are required for the ribbon transport.

In the coding positions of the automatic mail distributors each shipment is imprinted with an identifying mark in addition to the code, whch mark indicates at which coding machine the shipment was being processed. It consists of a number or a letter. With the aid of this mark it is possible, for example, when coding errors are discovered in the distributor, to identify the coding position where the error originated and then, with the aid of the work schedule, the operator.

Presently, this mark is applied by a separate "identifier" which is attached to the code printer. Printing is accomplished by an ordinary typewriter ribbon. Operator-identifying marks for outgoing and incoming mail are distinguished by black and red printing.

This identifier is relatively complicated (switching from red to black, reversal of movement of the ribbon, operation of the stamp, etc.) and it is susceptible to malfunction.

In a further embodiment of the printing mechanism according to the present invention a printing stamp is provided, which serves to imprint one or a plurality of identifying marks associated with the printing mechanism, and which is operated in synchronism with the code imprint and which uses the same ribbon at a point not covered by any track serving for the printing of the code elements.

This would not be possible with a ribbon transport according to the procedure of FIGURE 3 since the small steps s_2 of the ribbon are only approximately 0.6 mm. long. This is not enough to provide an unused portion of the ribbon for the appropriate stamps which are to imprint the position identifying mark.

However in the printing mechanism according to the present invention, each step s_4 is a multiple of s_2 with otherwise identical conditions, e.g., with a length of 2.5 mm. This provides enough space to print the identifying marks from an unused portion of the ribbon at each printing operation. It must be taken into consideration that the "filling effect" being evident from the right side of FIGURE 4 is true of the code elements only and not of the identifying marks, since at each step of the ribbon there are printed four columns of code elements and only one column of identifying marks.

The differentiation between incoming and outgoing mail in an automatic mail distributor results without further measures by the use of different colored ribbons for the code imprint (e.g., fluorescent or phosphorescent ribbons).

The printing of the position or operator identifying marks could occur in a marginal zone outside the tracks **4** utilized for the code imprint. The ribbon would then, however, have to be widened by about 2.5 to 3 mm. In a multiple-line arrangement of code elements **2'**, it is more advantageous to arrange the imprint of the associated identifying mark, as shown in the illustrated examples, between the tracks which serve to print the code elements.

This possibility is illustrated with an example in FIGURE 5, which otherwise corresponds to FIGURE 1. The position or operator identifying mark here consists of the four numbers 0–1–1–3, which are printed between the tracks **4** for the code elements **2'**. The identifying mark is disposed on the left of the code field since the shipment **1** moves into the scanning device with its right edge ahead. The code field has then already been read and the code stored when the identifying mark reaches the reading column. Thus, erroneous readings of an identifying mark by the reading head for the code elements, which may occur when shipments come in too high, can no longer interfere with the code.

There are other possibilities to utilize the ribbon area (intermediate zones) between the tracks **4** for the printing of a position or operator identifying mark. Thus, for example, for the first 10 coding positions the numbers 0 . . . 9 can be printed in the upper intermediate zone, for the coding positions 10 . . . 19 the numbers 0 . . . 9 can be printed in the second intermediate zone, etc. Up to forty coding positions can be marked with numbers and up to 104 coding positions can be identified with combinations of letters.

An example of a code printing device suitable to operate according to the invention is shown in FIGURE 6. The proper printing mechanism is diagrammatically represented by a box **10**. According to FIGURE 7 the printing mechanism is provided with five printing types **11** in each one of four columns and with four printing types **12** for the identifying marks in another column.

The printing mechanism **10** is so constructed that upon each printing step all printing types **12**, and in every one of the four columns two printing types **11**, corresponding to appropriate control signals fed into the printing mechanism **10**, are pushed forward against the ribbon **3**. Behind ribbon **3**, resting on a support block **13**, is a letter **14**. Transporting means which bring the letters **14** into printing position and carry them away subsequently are not shown here.

The ribbon **3** runs from a delivery bobbin **15** over two idle rollers **16** and **17** to a winding bobbin **18**. In FIGURE 6 bobbins **15** and **18**, including the respective ribbon coils, are partially cut away in order to show further elements which are arranged underneath and are described subsequently.

By means of a bevel-gear drive **19**, **20** and a slipping clutch **21**, winding bobbin **18** is connected to a continuously running winding motor **22**. Clutch **21** is adjusted so as to exert onto ribbon **3**, in the direction of arrow **23**, a continuous pull of predetermined amount.

Delivery bobbin **15** is connected to a brake wheel **24** onto which a brake shoe **25** is pressed by a tension spring **26**. The braking force acting on the ribbon **3** is adjusted to be essentially smaller than the pulling force from bobbin **18**.

Between idle roller **17** and winding bobbin **18** the ribbon **3** is led, by means of two guide rollers **27** and **28**, around a drive wheel **29** which is connected, by means of a common axle **30**, to a step wheel **31**. Step wheel **31** is part of a stepping mechanism comprising a forked check lever **32** and a stepping magnet **33**.

Check lever **32** is pivoted on an axle **34** and is swingable between two stops **35** and **36**. It is cooperating with step wheel **31** by means of two check pins **32'** and **32''**. In rest position check lever **32** is held at stop **35** by means of a tension spring **37**.

Every time the stepping magnet **33** is energized by a stepping pulse, check lever **32** is swung momentarily against stop **36** and back to stop **35**. By this motion step wheel **31** is stepped forward in the direction of arrow **38** by the amount of one tooth.

The number of teeth on step wheel **31** and the diameter of drive wheel **29** are chosen so as to move the ribbon **3**, at every stepping pulse, by a length of $s_4 = n \cdot t/z$ as defined above.

We claim:

1. In a code printing device for simultaneous n-digit code imprints with uniform spacing between the code elements and using a ribbon which is advanced after each printing operation in the direction of the printed line by one step so that for the next subsequent printing operation all types will be opposite an unused portion of the ribbon, the improvement comprising ribbon transporting means for always advancing a ribbon by equal steps having a length of

$$s = n \cdot t/z$$

where

t is the distance between code elements center to center,

z is the number of ribbon imprints disposed within distance t,

z and n do not have a common divisor,

and wherein

$$z \leqq \frac{t}{d + a_{\min.}}$$

where d is the width of one code element, and $a_{\min}$ is the minimum spacing between two adjacent ribbon imprints.

2. Printing device as defined in claim 1 wherein the improvement further comprises a printing stamp, which serves to imprint at least one identifying mark associated with the code imprint and which uses the same ribbon at a point not covered by the track serving for the printing of a line of code elements.

3. Printing device as defined in claim 2 wherein the code elements are arranged in more than one line and the printing stamp associated with the printing device is arranged to print between the tracks serving for the printing of lines of code elements.

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U.S. Cl. X.R.

101—102, 336; 197—82