

Nov. 20, 1962

A. MAUDUIT
DEVICE FOR CONTROLLING AN ELECTRONICALLY
OPERATED PRINTING MACHINE

3,064,561

Filed June 5, 1961

4 Sheets-Sheet 1

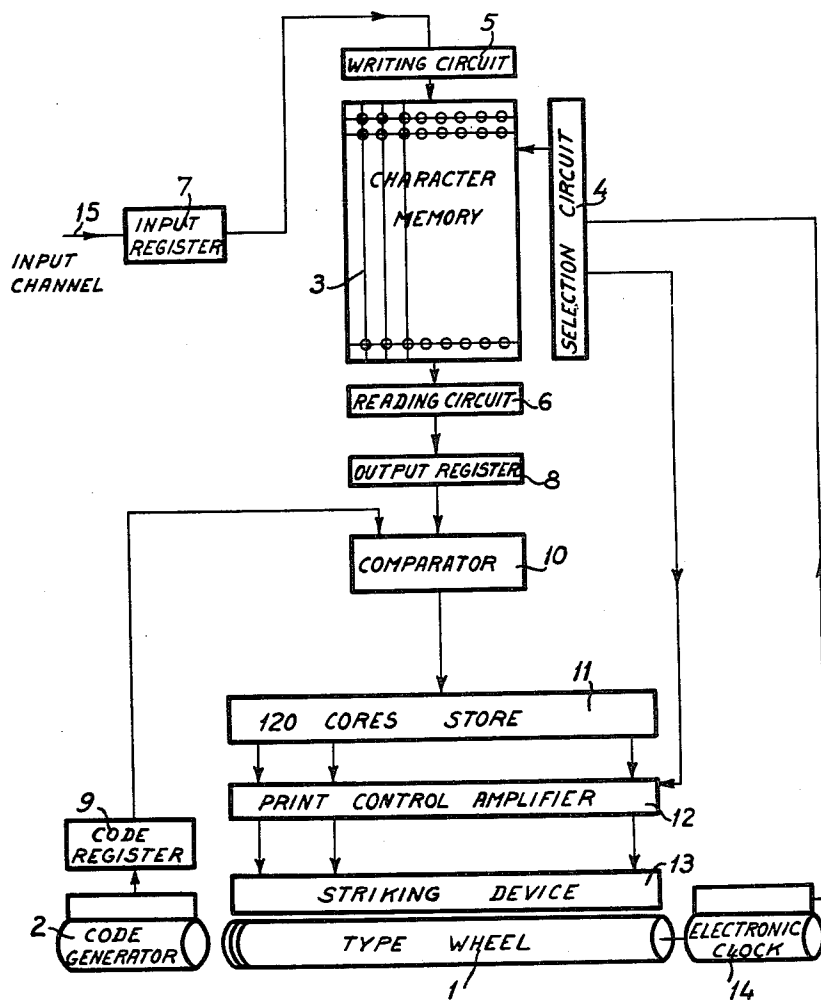


FIG. 1

Inventor:
Andre Mauduit
BY Baldwin & Wright
Attorneys

A. MAUDUIT
DEVICE FOR CONTROLLING AN ELECTRONICALLY
OPERATED PRINTING MACHINE

4 Sheets-Sheet 2

[illegible]

Inventor:
Andre' Mauduit
BY Baldurim & Night
Attorneys

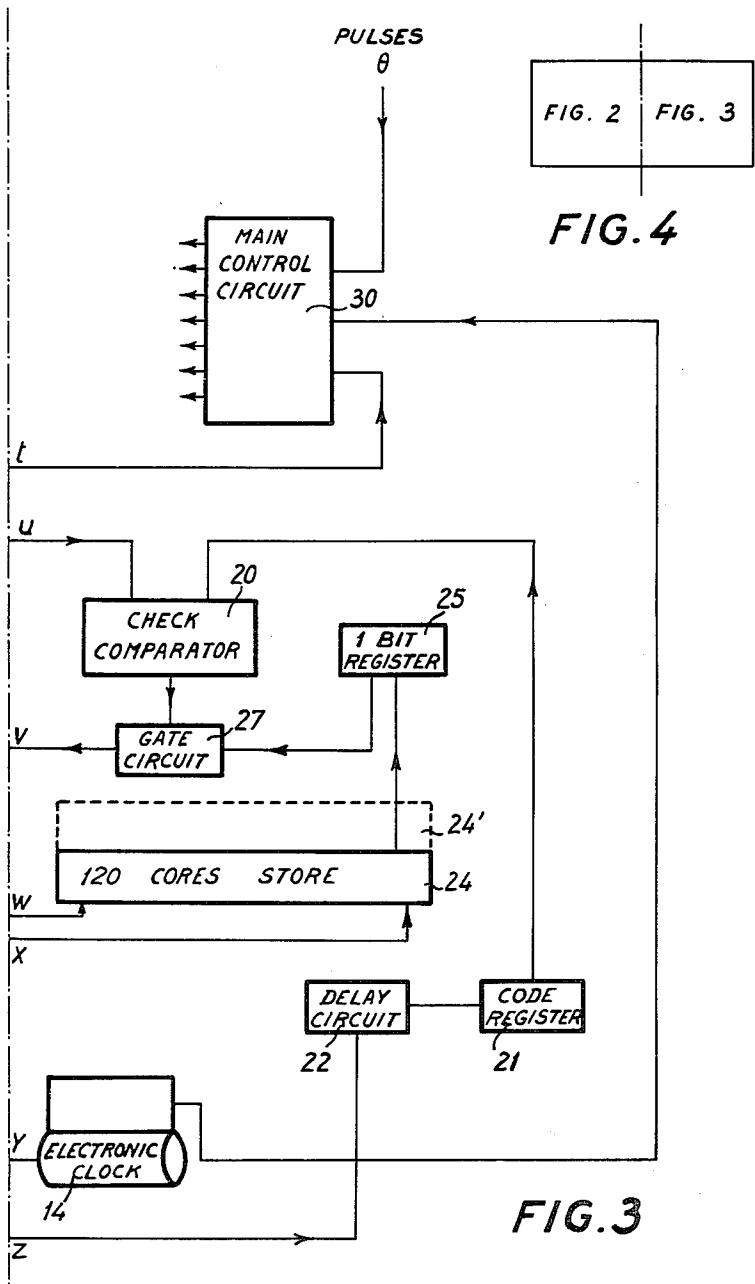
Nov. 20, 1962

A. MAUDUIT
DEVICE FOR CONTROLLING AN ELECTRONICALLY
OPERATED PRINTING MACHINE

3,064,561

Filed June 5, 1961

4 Sheets-Sheet 3



Inventor:
Andre' Mauduit
BY Baldwin & Night
Attorneys

Nov. 20, 1962

Filed June 5, 1961

A. MAUDUIT
DEVICE FOR CONTROLLING AN ELECTRONICALLY
OPERATED PRINTING MACHINE

3,064,561

4 Sheets-Sheet 4

FIG. 5

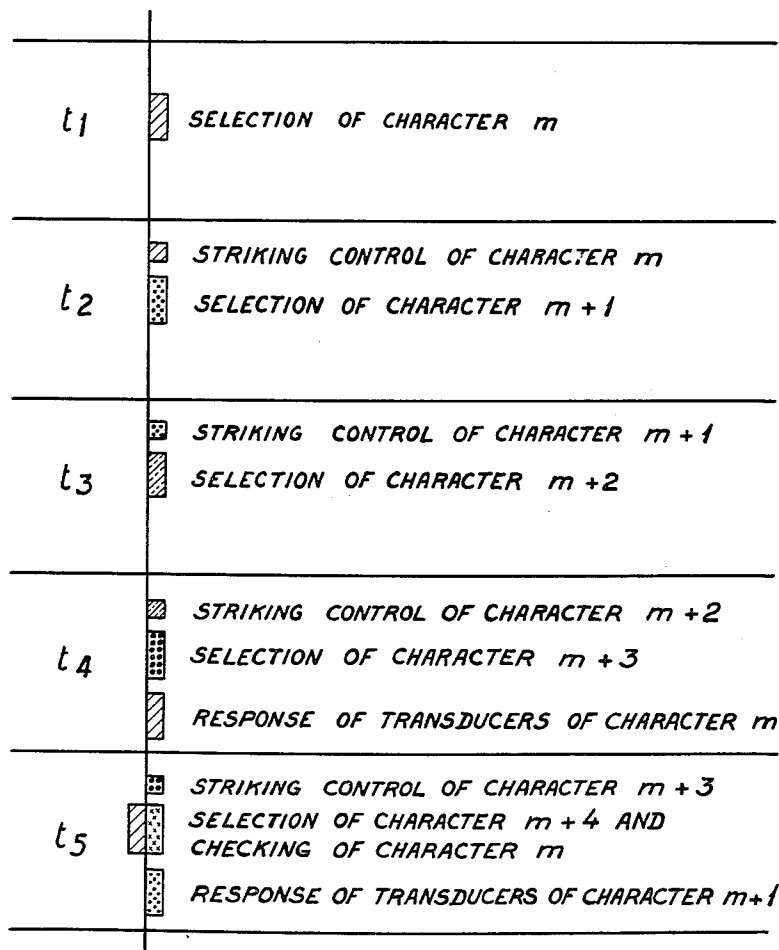
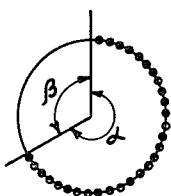


FIG. 6

Inventor:
Andre' Mauduit
BY Baldwin & Knight
Attorneys

1

3,064,561

DEVICE FOR CONTROLLING AN ELECTRONICALLY OPERATED PRINTING MACHINE

André Mauduit, Conflans Sainte Honorine, France, assignor to Compagnie des Machines Bull (Société Anonyme), Paris, France

Filed June 5, 1961, Ser. No. 114,995

Claims priority, application France June 14, 1960

11 Claims. (Cl. 101-93)

The present invention concerns a device for controlling an electronically operated printing machine, by means of which it is possible to check the identity between the printed text and the text sent to the control circuits of the printing machine in coded form.

The printing machine for which the device is intended is a fully electronically controlled machine which receives its information from an electronic computer or any complex data-processing assembly. The information takes the form of coded characters, each character being represented by a succession of binary pulses. The items of information received also comprise working instructions, indicating more especially the spacing between two lines, called the "jump" of the paper.

The printing device comprises a type drum formed of an assembly of identical wheels. If the printing line comprises 120 characters, 120 wheels each bear all the printing characters or types distributed on their circumference, or 60 wheels each bear two series of types, depending upon the constructions. The wheels rotate with an absolutely synchronous movement, so that they can all print the same character at the same instant in the cycle. The printing proper is carried out by 120 striker hammers which apply the paper against the type, these hammers being actuated by control electromagnets. The inking is effected by an interposed ribbon or carbon paper.

The principle of the electronic printing control is as follows: The type drum drives in its rotation a code-generating drum adapted to generate in an appropriate pick-up member a number of characters coded in accordance with the internal code of the computer equal to the number of character types on the printing drum. The said generator may consist of an assembly of toothed wheels, the number of which is equal to the number of binary positions of a character. The pick-up member then consists of the same number of magnetic heads bearing two windings, one of which is the primary winding and the other a secondary winding, so that the travel of a tooth past the air gap of the magnetic circuit varies the reluctance of the latter. A binary "1" or "0" corresponds to the presence or absence of a tooth on the wheel. The generator may also be a drum bearing magnetic marks and the pick-up member may consist of magnetic reading heads. The arrangement of the teeth or marks on the periphery of the drum is such that the coded character is generated in the pick-up member slightly before the corresponding printing character takes up a position in front of the striker hammers. Appropriate amplifiers are connected to the windings of the pick-up member.

Before the printing of a line, all the characters of one line have been registered in coded form in a store having 120 addresses.

The character produced by the code generator is written in a register and successively compared with each character extracted one-by-one from the preceding store. If the two coded combinations compared are identical, a signal is emitted by the comparing device and energises a position of an intermediate register comprising 120 positions. When the 120 characters of the line have been compared with the code character, a number of positions of the intermediate register may thus have been energised and then transmit a pulse to the striker ham-

2

mers, so that the character is printed in each of the corresponding line positions.

The cycle continues. Each character of the code-generating drum is thus compared with the characters of the line, so that the whole line has been printed at the end of the cycle.

The succeeding line is thereafter entered in the addressable store, and the printing thereof is carried out in accordance with the same process.

The checking devices already known for this type of printing machine only partially check the operations. They are intended to check that the coded characters transmitted through the device do not undergo any modifications in the course of the various transfers, and that a printing order has been transmitted to the striking control device for all the characters of the line before the change-over to the succeeding line. They do not permit of checking that the striking has been effective and that the struck character does in fact correspond to the coded character registered in the store in the corresponding position.

In contradistinction thereto, it is possible by means of the device according to the invention to effect a complete checking of the printing operation. It must be understood by this that it takes effect only from the instant when the mechanical striking device has become operative, in order to print the character on the paper, and that it checks that the striking is accurate, that is to say, that when the character has been struck, the position of the printing wheels is such that the code generated by the code generator does in fact correspond to the character registered in coded form in the store.

This result is obtained by the checking device according to the invention, which comprises a transducer device emitting a pulse each time a striking device has been actuated, a comparing device which compares the coded character transmitted by the processing machine with a character coded in accordance with the same conventions, generated by a code generator fast with the printing device and generating a comparing code in the case of identical characters, so that each emission of a comparing code which does not coincide with the emission of a pulse emanating from the transducer device, or conversely any pulse of the transducer device not coinciding with a comparing pulse produces the emission of an error signal.

For a better understanding of the invention and to show how it may be carried into effect, the same will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a general diagram illustrating the principle of an electronic printing machine,

FIGURES 2 and 3 are a general diagram of the electronic circuits associated with the printing devices,

FIGURE 4 is a plan view of FIGURES 2 and 3 in combination,

FIGURE 5 indicates the constitution of a printing cycle, and

FIGURE 6 indicates the distribution of the various printing and checking operations in the course of five successive cycles.

In FIGURE 1, there are shown:

- at 1 the printing type drum,
- at 2 the code generator,
- at 3 the character store,
- at 4 the store selecting circuits,
- at 5 the store writing circuits,
- at 6 the store reading circuits,
- at 7 the input register for the characters,
- at 8 the output register of the store whose capacity is 1 character,
- at 9 the register in which is written the character ema-

nating from the code generators, having the same capacity as that previously mentioned,

at 10 the comparing device in which are compared the characters coming from the registers 8 and 9,

at 11 the register having 120 positions consisting of 120 storage elements brought to the state 1 each time quality is detected in the comparing device 10,

at 12 the 120 energising devices for the striking control hammers,

at 13 the striking device, and

at 14 an electronic clock controlled by a toothed wheel rotating together with the drum.

The connecting channel 15 combines the printing circuits with the electronic computer. The characters are sent in coded form. The connection may be in series or in parallel for each character, without influencing the operation of the printing machine. The characters of one line are sent in series.

The principle of the operation of the printing machine may therefore be followed from FIGURE 1. All the characters of a line are unitarily sent to the register 7, in which they are passed through the writing circuits 5 of the store 3. The first character is written at the address 1, the second character at the address 2, etc., the selection being effected by the circuits 4, in which the store address is advanced by one unit at each writing of a character. When the entire store is full, the rotation of the printing drum 1 is such that the first coded character is generated by the code generator 2 and is written in the coded character register 9. A further selection from the store 3 is effected from the first character, which is extracted by the reading circuits 6 and written in the register 8. The characters written at 8 and 9 are compared in the comparing device 10. If they are identical, an output signal is emitted, which writes a binary "1" in the first position of the register 11. The character is re-written in the store. The selection then continues, and the 2nd, 3rd . . . 120th characters are progressively extracted from the store, sent to 8, compared at 10 with the same coded character, and each time that identity is detected the corresponding position of 11 is registered. When the 120 characters have thus been tested, a number of positions of the register 11 have been brought to the state "1." In the same time, the first type of the printing wheels, slightly retarded in relation to the coded character of the code generator, is positioned opposite to the striking hammers. A "striking order" is given from the synchronous clock rotating in step with the drum 14, so that the content of the register 11 is applied in the form of electric pulses to striking control devices 12 which actuate the electromagnets of the device 13 acting on the striking hammers, only in the positions in which the first character must be struck. The second character is then generated by the code generator and is written at 9. The store 3 is again entirely read, each character being compared with the character written at 9. The process continues until all the printing characters have been compared with the characters of the line and the entire line has been printed.

The operation thus described is synchronised by the rotation of the printing drum. Considering a machine printing N lines per second, the printing duration of a line is at most

$$T = \frac{1}{N}$$

seconds. This time T will be called the major cycle of the printing machine. If the drum comprises n printing types, the time t reserved for the comparison of a character with the characters of the store and its printing is at most equal to

$$t = \frac{T}{n}$$

t will be called the minor printing cycle of the printing machine. In fact, t is smaller than this value, because if

the drum has a continuous rotational cycle the types n are not distributed over the entire periphery of the printing wheels. They are distributed along an angle α in accordance with FIGURE 5. The angle β is a dead angle used between the comparing and printing cycles of two successive lines for the jump of the paper and the filling of the store 3 with all the characters of a line.

In a machine constructed in accordance with these principles, operating at 300 r.p.m. and possessing 60 characters per type wheel, $T=0.20$ second and t is lower than

$$\frac{0.20}{60} = 3.3 \text{ m./s.}$$

In fact, the 60 types are distributed along two-thirds of the circumference ($\alpha=240^\circ$) and consequently the duration of a minor cycle t is 2.2 m./s.

The principles of the operation of a printing machine thus having been set forth, there will be described in the following the devices according to the invention and the application of the checking means for ensuring accuracy of printing. In this description, reference will be made to FIGURES 2 and 3, in which the parts illustrated in FIGURE 1 are again to be seen.

In addition thereto, there are shown the members listed in the the following:

- at 20 a checking and comparing device of similar construction to the comparing device 10,
- at 21 a coded character register similar to the register 9,
- at 22 a delay circuit disposed between the coded character registers 9 and 21,
- at 23 a set of 120 transducers associated with the striking devices,
- at 24 a register composed of 120 storage positions, connected to the transducers 23,
- at 25 an intermediate register having 1 position registering the contents of one of the storage positions of 24,
- at 26 a parity key checking device,
- at 27 a gate circuit,
- at 28 a circuit for modifying the 7th and 8th positions of the characters,
- at 29 a circuit for scanning the 8th position of the characters.

There are also shown in FIGURES 2 and 3, at 30 the general control circuits of the printing device, at 31 the instruction register, at 32 the instruction scanner, and at 33 the paper "jump" control circuits.

In order that the operation of this assembly may be understood, it will be assumed that the printing machine, which is initially in the inoperative position, is connected to an electronic computer. It receives from the latter a working instruction signifying that all of the characters of one line will be sent to it from the store of the computer; a succession of instructions will thus be sent, positioned at 31 and scanned at 32. They comprise a certain number of indications, of which the coded indications of the spacing between the line being printed and the line which will be printed under the control of the present instruction, this information bearing the name "jump control" and being registered at 33.

The instant of the cycle at which the printing machine receives the instruction relating to the printing of a line will hereinafter be defined.

The process of printing a line, which lasts a major cycle T, may be divided into 3 successive operations:

- (1) Registration of characters in the store 3.
- (2) Comparison and printing of the characters type-by-type.
- (3) Printing check.

If, in accordance with the preceding example, there are 60 character types, the duration of the second operation is 60 minor cycles t, and the duration of the third operation is of the same length, but its performance is staggered by several minor cycles in relation to the second operation.

(1) Writing of the characters in the store.—When a

line has to be printed, the characters are successively sent into the input register 7, character-by-character. These characters are coded in accordance with a binary combination called the "internal code" of the computer and comprise a number of binary digits, for example 6, which are introduced into the register 7, in series or in parallel depending upon the internal arrangement of the computer. In the electronic circuits of the printing machine, on the other hand, the binary digits constituting the characters will preferably be carried in parallel between the various writing and storage circuits. A 7th binary digit accompanies the character, which is the "parity key" of the character. It is a 1 if the number of 1's contained in the character is even, and a 0 if it is odd.

Each time a character is introduced into 7, a control pulse is sent from 30 into the selection circuit 4 of the store 3, which comprises a switching circuit, so as to select successive store lines, the store 3 consisting of a matrix of magnetic cores having 120 columns, selected in accordance with the principles of double coincidence which is well known in this technique. The character written in 7 is transferred into the writing circuits 5 after passing through the register 8 and after the checking of the parity key 26. This check has another object which will hereinafter be explained.

Each line of cores of the store 3 comprises, not 7, but 8 cores. The characters are written in 6 cores, while the seventh contains the parity key. The eighth is left in the state 0 in the initial writing of the characters. This core is dependent upon the device for the checking of the printing as hereinafter described. It will be changed over to the state 1 after printing and checking of the character. The 120 characters are registered in the store 3.

(2) *Printing of the line.*—When the store is completely filled, the printing process starts. It is carried out in accordance with the general principle hereinbefore described by comparison, in the comparing device 10, between the coded character emanating from the code generator 2 and all the characters extracted unitarily from the store.

Each character is read in the reading circuits 6 and then sent into the register 8. In fact, it is not 6 binary digits, but 8, which are extracted from the store, only the 6 binary digits of the character being transmitted to the comparing device 10, plus the parity code if it is generated by the code generator at the same time as the character. If there is not identity, the comparing device 10 transmits no signal. If there is identity, a signal is sent to the register 11, which is a 120-position register consisting, for example, of 120 magnetic cores. On the core corresponding to the position of the character in the printing line is capable of changing its state under the action of this control, because the switching device which conditions the selection of characters at 4 also acts on a device for the successive selection of the cores 11, so that a current is sent only to the selected core. Therefore, at the end of a complete reading of the store 3, only a certain number of cores are in the state 1, these cores corresponding to the positions of the characters which, since they are identical to the characters generated by the code generator, must be printed. When all the store has been read, an electrical signal called the reading current is sent into the set of cores of 11, and the output wires of the cores are passed through an amplifying system 12 having 120 independent circuits which, under the action of the variation of the current generated in the reading windings, supply a substantial current sent into electromagnets which control the striking hammers. These amplifying circuits may be either thyatron circuits or power transistor circuits. With regard to the printing system 13, there may be employed the apparatus described in patent application Serial No. 842,841, filed September 28, 1959, now Patent No. 3,030,882, issued April 24, 1962.

The comparison and then the striking of the character

must obviously be absolutely synchronised with the rotational movement of the printing drum. The electronic clock 14 performs this synchronising function. It comprises a toothed wheel having 9 teeth and rotating at a speed 10 times higher than the speed of the drum. These teeth travel past a magnetic head similar to that provided for use with the code generator. The signals received, in suitably amplified form, are recurrent signals whose period fixed the duration of a minor signal as previously defined. They are employed to fix the commencement of the reading of the cores of the register 11 and hence the control of the striking devices. They are sent to the general control circuits and serve as a time base for determining the succession, which will hereinafter be more clearly defined.

(3) *Printing check.*—In order that the printing may be correct, it is necessary that:

(a) the character should not have changed in the course of the successive transfers,

(b) the striking order transmitted by the amplifying system should effectively result in a mechanical displacement of the striking hammer, which has the effect of applying the paper to the character on the type wheel, and

(c) the printed character should agree with the character expressed in coded form.

The check (a) is made by checking of the parity key before the writing in the store 3 and after each extraction from the store.

In order to effect the check (b), a printing device such as that described in the aforesaid patent application is employed: The displacement of the striking hammer varies the air gap of an auxiliary electromagnet which carries a receiving coil on its magnetic circuit. This member will be called the checking transducer to indicate that a mechanical displacement has been used to create an electrical signal.

The signal given by the coil will be employed to effect the check (c).

The 120 transducers 23 are combined with a set of 120 magnetic cores (24) constituting a register. If in the course of a minor cycle t a number of characters have been printed, the same number of transducers whose positions are those of the characters struck along the line generate checking signals a period of time τ after the control of the striking of the character and change the state of the same number of cores of the register 24, occupying corresponding positions.

During this time τ , which may cover a number of minor cycles, the coded character, which corresponds to the printing type which has just been struck and which has been registered at 9, is applied to a delay circuit 22, which delays it by the duration τ , and sends it after this period of time into the delayed code character register 21. At the selection of the store 3 which follows the writing of the code character in 21, the characters extracted from 3 and written in 8 are sent, not only into the comparing device 10, but also into a comparing device 20 which receives, on the one hand, the said characters and on the other hand the retarded code character emanating from 21. In the same time, the switching system which simultaneously controls the selection of the store 3 and the entry in the register 11, controls the reading of the magnetic cores of the store 24. If a core has changed its state, a binary 1 is written in the intermediate register at 1, position 25.

If character identity is found in 20; it is because the character of this position of the line was identical to the coded character read at the previous time τ . Therefore, the printing must have been effected, the transducer has emitted a signal stored in this position of 24, and a binary "1" must be entered in 25.

A gate circuit 27 is connected on the one hand to the output of the comparing device 20 and on the other hand to the register 25.

Various cases may arise:

The comparing device does not detect any identity, but the register 25 is in the state 0: No character has been printed in this position of the line.

The comparing device indicates an identity (output signal at the output of the comparing device) and the register 24 is in the state 1. Printing has taken place at this position of the line, which is correct since the character in this position is identical to that generated at this instant by the code comparing device. The output of the gate 27 emits a signal.

The comparing device indicates an identity, but there is no "1" in the register 24, or conversely there is no identity, but there is a "1" in the register 25: the printing is defective either because it has not taken place or because it has taken place wrongly.

The gate therefore has two outputs, the first of which (given by an "AND" circuit) gives a 1 only if the striking has taken place and it is correct, while the second (given by an "exclusive OR" circuit) indicates the case of an error in appropriate visual indicating systems. The first output controls the re-writing of the character in the store 3. The character is sent to the modifying circuit 28 situated between the register 8 and the writing circuits 5.

If this output indicates an 0 or the absence of a signal, the character is reproduced without change and rewritten in 3. The selection of the character entered in the following column of the store takes place only after this re-writing. If this output indicates a 1, the last two positions are modified, because a binary "1" is entered in the eighth position, which has hitherto been at zero. Consequently, the parity key is reversed, and the seventh position is therefore also modified. The registration of the eighth position therefore indicates that the character of this column is printed, that the printing has been checked and that it is satisfactory.

The succession of the various operations hereinbefore described will be more readily understood with reference to the diagram of the times of FIGURE 6. It has been assumed by way of numerical example that the minor cycle $t=2200 \mu s$. and that $\tau=5000 \mu s$. by reason of the inertia of the mechanical parts. In this figure, five successive minor cycles t_1, t_2, t_3, t_4 and t_5 are considered and it is assumed that at the cycle t_1 the character generated by the code generator and entered in 9 is the m th character of the type wheel.

Therefore, the printing position of the character m is selected. It will also be assumed that the beginning of the cycle is given by the signal emanating from the clock 14, which determines the control of the device 12 actuating the striker hammers and that the coded character following the struck character is generated by the code generator several tenths of a microsecond after the striking control.

The cycle t_2 therefore commences by the control of the striking of the character m in all the desired positions, and continues by the generation of the coded character $m+1$, and the selection of this character, a complete reading of the store 3 lasting about $600 \mu s$. The striking control has determined a slower mechanical action and the response of the transducers corresponding to the character m will therefore be received at the cycle t_4 .

At the cycle t_3 , the striking control of the character $m+1$ is carried out, and then the selection of the character $m+2$.

At the cycle t_4 , the striking control of the character $m+2$ is followed by the selection of the character $m+3$, but in the course of this cycle, a time greater than $5000 \mu s$. has elapsed since the striking control of m (at the cycle t_2). Therefore, a response is obtained at the cores of 24 in the course of the cycle.

In the succeeding cycle t_5 , there take place:

the striking control of the character $m+3$,

the selection of the character $m+4$,

the control of the printing of the character m , in accordance with the comparing process described, the two op-

erations, i.e. the selection of the character $m+4$ and the checking of the character m , being simultaneous (obviously there will never be equality in the comparing devices 10 and 20).

The response of the transducers of the character $m+1$ will thereafter be received in the same cycle.

Since the register 24 consists of store elements comprising cores, writing and reading cycles can never take place in the same fraction of a cycle. Now, the response time of the transducers depends upon the inertia of a mechanical device and can consequently undergo uncontrolled variations which might interfere with the succession of the cycles as hereinbefore described. In order to avoid such defects in operation, a simple arrangement may be provided which consists in providing two identical registers 24 and 24' each consisting of 120 cores, the writing windings of two cores of like position being connected in parallel to the corresponding transducer. A simple switching system alternates the functions of the two registers, so that in a cycle, if 24 receives the pulses from the transducers, it is 24' which is read position-by-position for checking in 20. On the other hand, in the succeeding cycle, the writing effected in 24 in the preceding cycle is read, and the responses of the transducers are written in 24'. Thus, the writing time may overlap the reading time, and it will be noted that the reading, which is an integral part of the store selection operations, is always situated in the same fraction of a cycle, and that it is the writing, related to the response of the transducers, which may undergo some shift within a cycle.

The checking device hereinbefore described therefore has the effect of locating a "1" in the 8th core position of a line of the store 3 when the character entered in this line has been printed and the accuracy of the printing has been checked. Consequently, when a complete line has been printed, the 120 cores of the 8th column contains a "1" in the location of the initial "0". It is therefore possible to pass to the operations preceding the printing of the following line, namely paper jump and filling of the store 3 with the characters of the following line.

The scanning circuit 29 scans the state of the 8th position in order to determine the instant when the 120 positions of the store are in the state 1. A first arrangement will consist in carrying out an additional store reading when the 60 characters of the printing wheel have been compared with the characters of the line, that is to say, at the beginning of the cycle β (FIGURE 5). At this stage, it is necessary to have identified the 120 characters with one of the 60 characters of the wheel. More exactly, this final check reading should take place 4 minor cycles after the striking control of the last character of the wheel, by reason of the response time of the transducers.

As already stated, during the time β , the "jump" of the paper in accordance with the number of interlines indicated in the instruction sent by the computer takes place. This time is sometimes too short when the "jump" exceeds the number of several interlines, or when it is necessary to change sheets of a certain length. Now, the printing drum continuously rotates and if the "jump" is not completed in the time allotted thereto, a major printing cycle is lost.

In order to increase the probability of effecting the "jump" without losing cycles T , the most probable distribution of the alphanumerical characters in the commonest commercial documents has been studied. Thus, the distribution of letters on the printing wheel does not follow the alphabetical order, but depends upon their frequency in the wording of the forms and other documents. It may thus be assumed that in a large number of cases the printing of a line will be completed well before the 60 characters of the type wheels have been explored, and the jump control operations may be started before the end of the cycle α .

In order to benefit by this advantage, the 8th position of each character is introduced into the scanning circuit

29 at each reading of the store 3. This circuit is therefore disposed after the reading circuits 6. It consists of a flip-flop having two stable states which is placed in the state "1" at the beginning of each reading cycle. It remains in this state as long as the signal received (8th position of each character) corresponds itself to a 1. It is returned to the state 0 at the first zero signal received and remains in this state. In other words, the extraction of the first unprinted character from the store 3 resets the scanning circuit 29 to zero. If, on the other hand, all the characters have been printed and checked, the 120 successive characters have a "1" in the 8th position, and the flip flop is not returned to zero. At the end of the cycle it sends a signal to the control circuits, which has two effects:

the control circuits send a signal to the computer, which determines the despatch of the 120 characters of the succeeding line,

the control circuits send a signal to the jump control circuit 33, in which the length of the jump is written, that is to say, the number of interlines between two successive printing lines. The signal starts the clutch engagement system which controls the movement of the paper, the description of which is of no interest to the present invention. At each displacement corresponding to a line, a pulse is sent to the circuit 33, in which it subtracts one unit from the number entered until this number is zero. The jump device is then rendered inoperative.

At the same time, the characters constituting the following line are written in the store 3 in accordance with the process already described. At the moment when the "jump" is completed and when the store 3 is completely filled, the printing can commence when the first character of the code generator is generated, and if at this instant the jump has not been completed, it is necessary to wait for one cycle T until the first code character is regenerated.

It will be noted that the instruction emanating from the computer and concerning a line l is sent to the circuits of the printing machine when all the characters of the preceding line $l-1$ have been sent into the store, and before it is printed. Thus, the instruction is written in 32. When the printing of the line $l-1$ has been completed, the printing machine is thus in possession of the particulars which it requires for preparing for the printing of the line l , in particular the length of the jump between the lines $l-1$ and l .

A last arrangement also concerns the making-up of a page. The printing lines contain a number of spaces which cause characters all equal to zero to be sent into the store. These characters do not correspond to any of the characters generated by the code generator. They are located in the following manner: When the characters are transferred from the input register 7 to the writing circuits 5 of the store 3, they are first sent into the register 8 and tested in the comparing device 20, of which the second comparing element is set at zero. If identity is detected, everything happens as if character identity existed in this member. The modifying circuit becomes operative to locate a "1" in the 8th character position, and the character is thereafter sent from 8 to the circuits 5.

In the printing circuits, the presence of the "1's" in the 8th positions of these characters will enable them to be considered in the same way as the characters actually printed.

However, it will be noted that in order that this process may result in an accurate printing it is necessary to avoid confusion of the spaces with the zeros which have to be printed within a numerical datum, and that consequently the true zeroes will have to comprise in their written form a symbol by which they can be recognised. This differentiation may be effected with

in the circuits of the computer or in the circuits accompanying the printing machine.

The various members employed in the electronic control and checking circuits of the printing machine may be designed with technological structures similar to those provided in the electronic computer with which the printing machine is associated. Some particulars will be given by way of example, but any other construction by which the described operations can be carried out may be adopted.

The control circuits 30 consist of a series of logical circuits which successively supply control pulses to the circuits which they control. They consist of a succession of flip-flops connected one behind the other by logical "AND" and "OR" circuits in which the set of signals permitting the control of the action initiated by the flip-flop following them are combined. The actions thus controlled include: The sending to the computer of demand signals for providing for the despatch of the instructions and characters to the transfer channels; the control of transfers between the various registers described, the initiation of the selecting operations. The additional time conditions depending upon the printing cycle produce pulses emitted by the electronic clock 14 and applied to the logical circuits. The "AND" and "OR" circuits are diode circuits of standard type which emit a pulse at the output if a pulse is applied at each input. The other time conditions having a cyclic character within a minor cycle are defined by elemental rhythmic pulses of a periodicity of 10 microseconds consisting of 10 recurrent rhythms staggered by 1 microsecond, in relation to one another, and called $\theta_0, \theta_1, \theta_2 \dots \theta_9$. The rhythmic pulses are distributed by a pulse generator which may be in the computer or associated with the printing machine. Thus, the selection of the store 3 is initiated by the pulses emanating from the clock 14, and the address switching in a total reading of the character comparing cycle is automatically governed by the rhythms θ and θ_9 and thus lasts 600 microseconds.

The character registers (7, 8, 9, 21) are of the parallel type and comprise a number of bistable circuits equal to the number of binary digits which they have to register (6 if they comprise the character alone, and 8 with the parity code and the checking position.) They may consist of bistable trigger circuits of the flip-flop type comprising valves or transistors or of transistor amplifiers which, under the action of a positive input pulse, change from an initial output level 0 to a final level 1, and in which a feedback from the output to the input maintains the final level 1, as long as a return to zero in the form of a negative pulse does not cancel the effect of the feedback. The transfer from one register to another is effected by connecting together two circuits of like order through an "AND" circuit, to which there is applied the transfer control pulse sent in parallel to the 6 (or 8) circuits of the register.

The store 3 is, as stated, formed of a plane matrix comprising magnetic cores having a rectangular hysteresis loop and having 2 stable states, forming a network of 8 lines and 120 columns. Each core has 5 wires passing therethrough: a biasing wire common to all the cores, through which there passes a current equal to one-third of the change-over current, a reading selection wire through which there passes a current of the same direction as the preceding current and equal to two-thirds of the change-over current, a writing selection wire through which there passes a current equal to and of opposite direction to the preceding current, a writing wire, and a reading wire.

The selection wires extend through all the cores of one column, and the writing and reading wire through all the cores of one line. To write a "one," there is sent through the writing wire a current equal to the selection current and of like direction. To write an "0," no current is sent. The reading selection, on the other hand,

changes over the core from 1 to 0 if it is in the state 1 and therefore generates an induced current in the reading wire, the core remaining in its state if it is in the state 0. The selection circuits comprise current generators generating currents in one direction for writing and in the other direction for reading. They are combined with the wires through the cores by alternately changed over switches which may be transistor circuits rendered conductive at the instant of the selection. Since reading destroys the information, successive reading and writing are carried out within an elemental cycle between two selections. The written datum is either the character of a new printing line emanating from the input circuits or the character which has undergone the comparing and checking cycle.

The writing circuit 5 comprises an electronic current generator which sends a current into the writing wire if the binary datum to be written is a "1." The current generator is therefore connected to the writing wire of the lines of cores by a transistor switching circuit which is conductive for a binary "1" and non-conductive for the writing of a binary "0." The circuit 5 comprises 8 generators and 8 switching circuits. The reading circuit 6 is connected to the reading wires of the lines of cores and comprises 8 electronic amplifiers designed to shape and amplify the pulses collected at the reading wires during a change of state in a "reading" selection cycle. These amplifying circuits are rendered non-conductive outside the reading time in order that parasitic pulses may not be picked up. The output of the 8 amplifiers is connected to the 8 positions of the register 8.

The comparing circuits are logical circuits which combine in parallel the corresponding outputs of the registers containing the data to be compared, that is to say, they contain 6 circuits carrying out the binary operation $a.b + \bar{a}.b$, and supply a signal if these six circuits give a response equal to 1, which indicates identity of the characters. These circuits are constructed with the desired number of diode circuits and inverting circuits.

The writing circuit 11 consists of a set of 120 magnetic cores of toroidal form, around which there are disposed three windings: the first winding is a writing winding connected to a current generator through a switching circuit. The switching circuit, which comprises a normally non-conductive transistor, is rendered conductive by a double logical condition: identity of character (signal supplied by the comparing device 10), and selection of the corresponding line position, which results in two signals being applied to an "AND" circuit. If these conditions are satisfied, the current is sent into the writing winding and changes over the state of the core. The second winding is a reading winding connected to one of the amplifying circuits of 12, and the third a reading control winding common to all the cores and connected to a reading control current generator through a switching circuit rendered conductive by a control signal due to the electronic clock 14, so that all the cores are read at the same time. The amplifying circuits 12 may be transistor circuits whose power is defined by the coil circuits of the striking control electromagnets.

The circuits for writing the response of the transducers 24 and 24' also consist of 120 magnetic cores having a number of windings, but it is the writing control which is this time effected by a common wire alternately at 24 and 24', while the reading is selectively effected in dependence upon the selection of the store 3. There is therefore a writing control winding connected to a current generator, so as to write in one instance on all the cores at 24 and in the other instance on all the cores at 24', each winding of 24 being connected to a transducer in parallel with the winding of the corresponding core of 24', a reading selection winding connected to a current generator through a switching circuit, and a reading winding in which a current is induced in the event of the change over of the core under the action of the reading selection current.

The device also comprises the delay circuit 22, which may consist of 8 shift registers, each of which is intended to delay a binary character digit, and whose outputs are sent to the register 21.

Any other storage and writing arrangements which may be employed instead of the described circuits fall within the scope of the present invention.

I claim:

1. In a printing machine connected to a data-processing machine and including a plurality of striking devices and a rotating type drum, a device for checking printing intended to verify that the printed characters are equivalent to the coded characters transmitted by the processing machine, comprising generator means for generating a checking pulse each time a striking device has been actuated, a character-code generator fast with said type drum, an equality comparing device comparing at each instant the coded characters transmitted by the processing machine with the character coded in the same code generated by the said code generator, switching means associated with said generator means and with said comparing device, so that it delivers an error signal when identity of the said coded characters is detected by said comparing device whereas no pulse is supplied by the said generator means, or when a pulse is supplied by the said pulse generating means whereas the comparing device does not detect identity of the said coded characters.

2. In a printing machine connected to a data-processing machine and including a plurality of striking devices and a rotating type drum, a device for checking printing intended to verify that the printed characters are equivalent to the coded characters transmitted by the processing machine, comprising generator means for generating a checking pulse each time a striking device has been actuated, a code generator fast with said type drum, an equality comparing device comparing at each instant the coded characters transmitted by the processing machine with the character coded in the same code generated by the said code generator and generating a comparing pulse when the said characters are identical, a coincidence circuit connected to said generator means and to said comparing device in order to be actuated at its inputs by the checking and comparing pulses and supplying an error signal at its output when only a single pulse is active at its inputs.

3. In a printing machine connected to a data-processing machine and including a plurality of striking devices and a rotating type-wheel, in which all the characters of one line transmitted in coded form from the processing machine are written to be stored in a character store, an arrangement for checking printing and designed to verify that the printed characters are equivalent to the coded characters stored in said store, comprising for each printing position a transducer device emitting a checking pulse each time an associated striking device has been actuated, a code generator fast with said typewheel, an equality comparing device comparing the coded characters extracted from the position of said store with the character coded in the same code generated by said code generator and emitting a comparing pulse when the said characters are identical, a coincidence circuit operatively connected to said transducers and said comparing device in order to be actuated at its inputs by the checking and comparing pulses and producing at one output the despatch of a checking symbol towards the store position containing the printed character each time the two pulses are present or producing at a second output the emission of an error signal when only a single pulse is active at its inputs.

4. Arrangement for checking printing according to claim 3, wherein a scanning circuit cooperates with said character store for detecting that a checking symbol has been entered in each position of the character store and for permitting the writing of the characters of the following line from the processing machine into said character store.

5. In a high speed printing machine in which all the

characters of a line to be printed are stored in a character store and including a rotating type drum, a plurality of striking devices and also a character-code generator operated in synchronism with said type drum, an arrangement for checking the effective printing of the characters repeatedly read-out from said store, comprising a transducer device emitting a checking pulse each time a striking device of a corresponding position has been actuated, a delay device delaying the coded character emitted by said code generator by a time duration at least equal to the response time of the striking mechanism, a code comparing device which compares the coded character emanating from said delay device with the coded characters extracted from the store positions corresponding to that of the struck characters in the printed line, and which emits a comparing pulse when the said characters are identical, a coincidence circuit operatively connected to said transducers and to said comparing device to be actuated at its inputs by the checking and comparing pulses, and producing at one output the despatch of a checking symbol into the store positions containing the printed characters when the two pulses are present, or producing at a second output the delivering of an error signal when only a single pulse is active at its inputs.

6. Checking arrangement according to claim 5, wherein an analyser circuit is operatively connected to said character store for verifying that a checking symbol is stored in each position of the character store and for causing the entry of the characters of the following line into said store.

7. In a high speed printing machine in which all the characters of a line to be printed are stored in a character store and including a rotating typewheel, a plurality of striking devices and a character-code generator operated in synchronism with said typewheel, an arrangement for checking the effective printing of the characters repeatedly read-out from said store, this arrangement comprising a series of transducer devices each associated with a device for striking a character and for supplying a pulse when the striking device of this position is actuated, a register of which each registering stage is connected to the output of a transducer for registering the pulse emitted by each transducer, a delay device delaying the coded character emitted by the code generator by a time duration at least equal to the response time of the said transducer devices, a synchronising device which produces the successive reading-out of the characters from the character store, and in synchronism the sequential exploration of said register, a pulse comparator connected for constantly comparing the characters read-out from said store to said delayed character-code, a coincidence circuit receiving at one input a comparing pulse emitted by the comparing device in the event of equality of the characters, and at a second input the reading pulse extracted from said register if a pulse has been registered in the corresponding position, so that the simultaneous application of a comparing pulse and of a reading pulse to the said coincidence circuit produces at one output of the said circuit the emission of a checking symbol, while the application of a comparing pulse in the absence of a reading pulse, or of a reading pulse in the absence of a comparing pulse produces the emission of an error signal at a second output of the said circuit.

8. In a high speed printer including a continuously rotating typewheel having type elements arranged in rows parallel to the axis of said typewheel, and a row of striking hammers in proximity to said typewheel, the arrangement comprising a matrix memory for storing a number of character representations in memory locations, each containing at least a further memory cell other than the necessary cells for all the code components, first means cooperating with said memory for sequentially and repeatedly reading-out and re-entering all the character representations of the line to be printed, writing means adapted to enter a check symbol into said further memory cells, a number of transducers emitting each a pulse each time an associated striking hammer has effectively printed a character in a corresponding position, a register comprising a registering element for each printing position, said elements being connected to the corresponding transducers in order to be set in a registering state upon receipt of said pulse so emitted, said register having an output terminal, second means for sequentially reading-out the content of said register, which content appears at said output terminal, a generator for generating a different character-code at each printing cycle, connected to feed a delay network and a register for a delayed character-code so that the latter is available after the emission of said pulses, a comparing device having inputs which are connected to said first means and to said register for delayed character-code, and having an output which delivers an equality signal each time a character read-out from said memory is identical to said delayed character-code, and a controlling coincidence circuit having inputs connected to the output of said comparing device and to the output of said register, and having also an output connected to said writing means for causing the latter to enter a check symbol each time a character has been effectively and correctly printed.

9. Arrangement according to claim 8, comprising sequential location selecting means which synchronously control both said first means and said second means.

10. Arrangement according to claim 8, wherein said first means are arranged to sequentially read-out also the contents of said further cells of the memory, said arrangement comprising an analyser circuit connected to the output circuit of said memory to verify after printing of a complete line that all of said further cells contained a check symbol.

11. Arrangement according to claim 10, wherein said coincidence circuit further comprises an "exclusive or" device for emitting an error signal at its output.

References Cited in the file of this patent

UNITED STATES PATENTS

2,776,618	Hartley	Jan. 8, 1957
2,799,222	Goldberg et al.	July 16, 1957
2,915,966	Jacoby	Dec. 8, 1959
2,915,967	Gehring et al.	Dec. 8, 1959
2,941,188	Flechtner et al.	June 14, 1960
2,966,113	Deerfield et al.	Dec. 27, 1960
2,978,977	Eckert et al.	Apr. 11, 1961

Notice of Adverse Decision in Interference

In Interference No. 93,818 involving Patent No. 3,064,561, A. Mauduit, **DEVICE FOR CONTROLLING AN ELECTRONICALLY OPERATED PRINTING MACHINE**, final judgment adverse to the patentee was rendered July 14, 1965, as to claims 1, 2 and 3.

[Official Gazette September 28, 1965.]