March 12, 1963 J. E. J. G. TOUSSAINT 3,081,446

DECODING AND PRINTING SYSTEM

Filed April 13, 1959 10 Sheets-Sheet 1

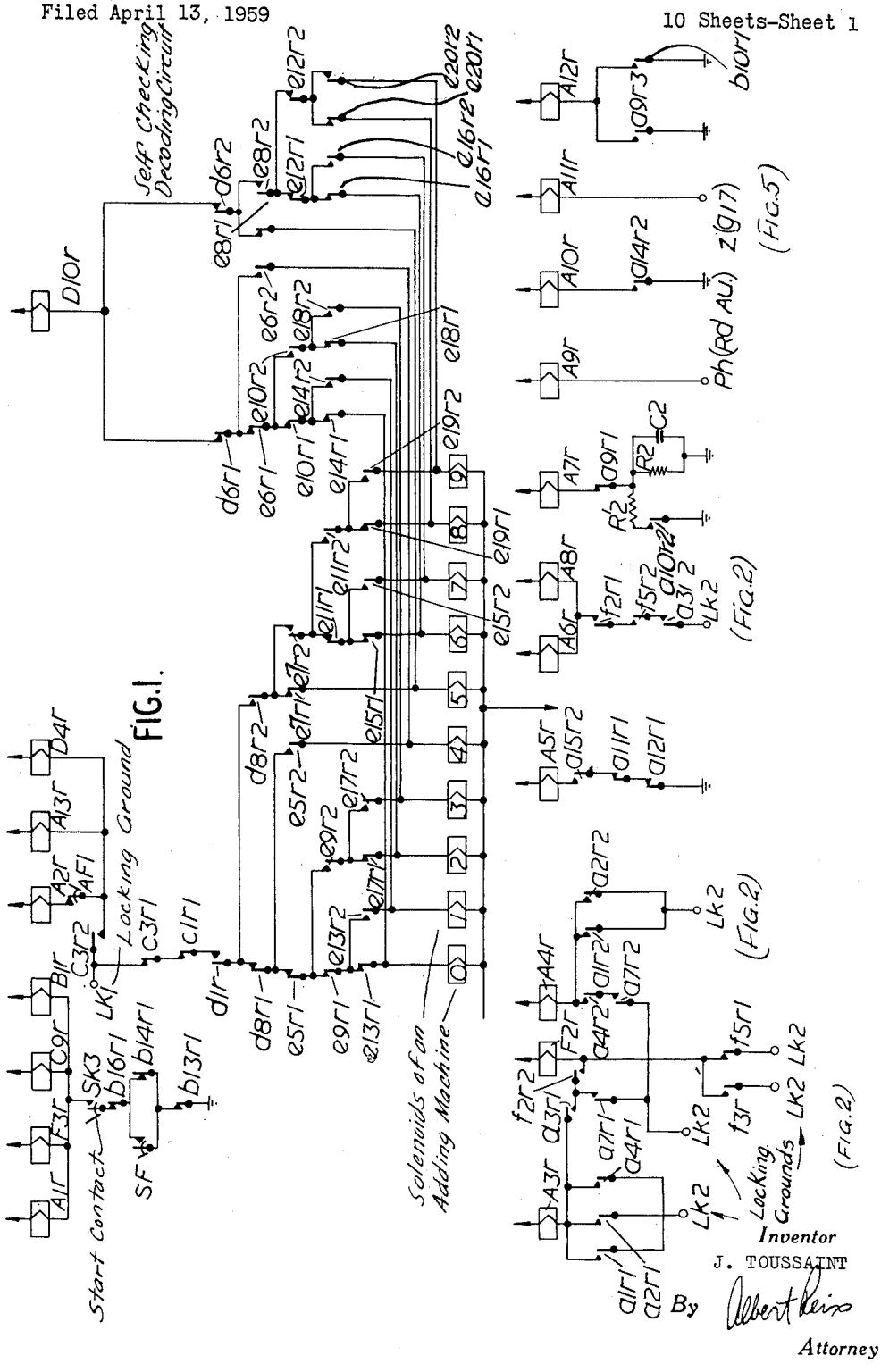

FIG. 1.

Inventor
J. TOUSSAINT
By Albert Reiss
Attorney

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DECODING AND PRINTING SYSTEM

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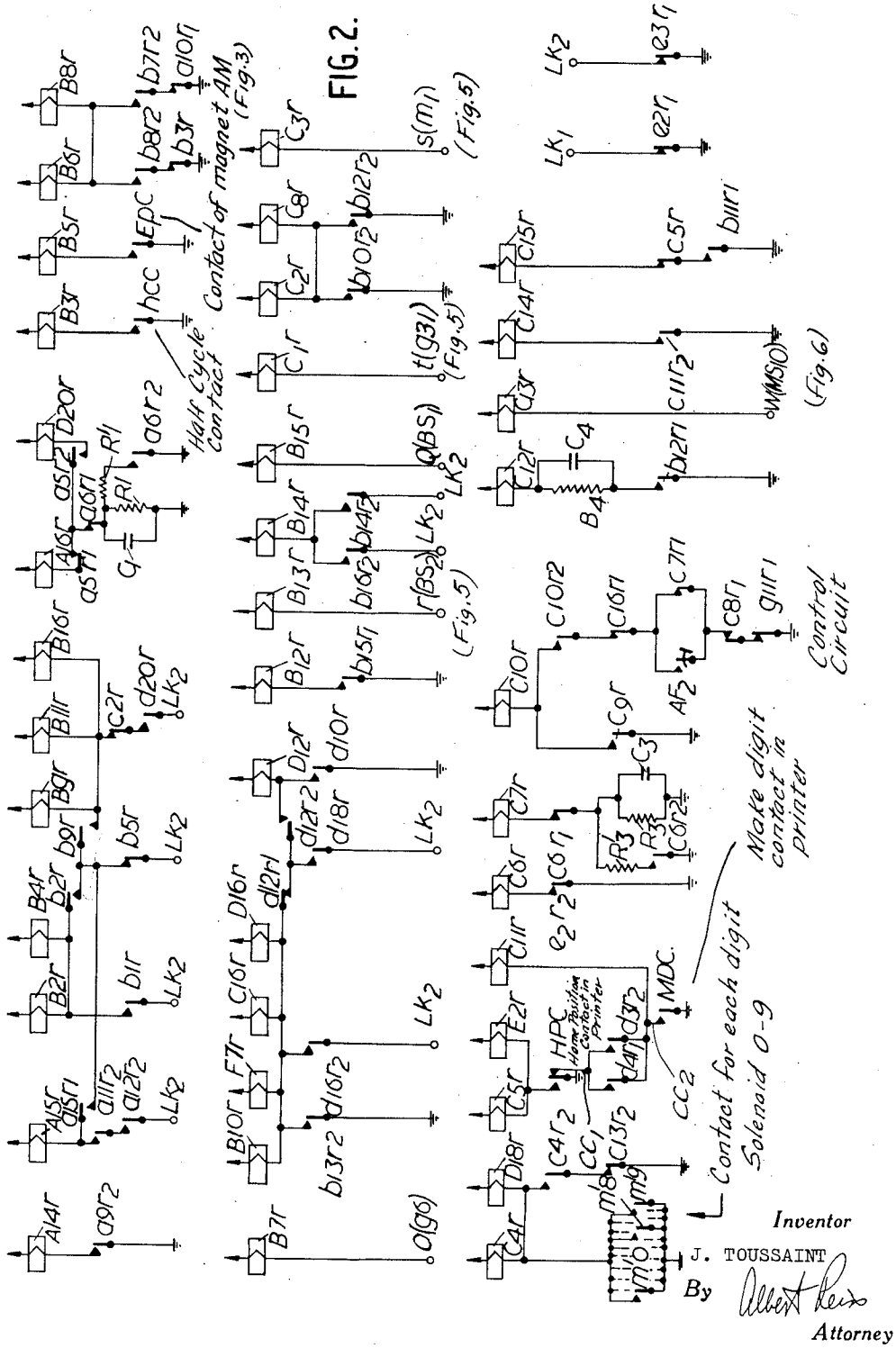

FIG. 2.

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DECODING AND PRINTING SYSTEM

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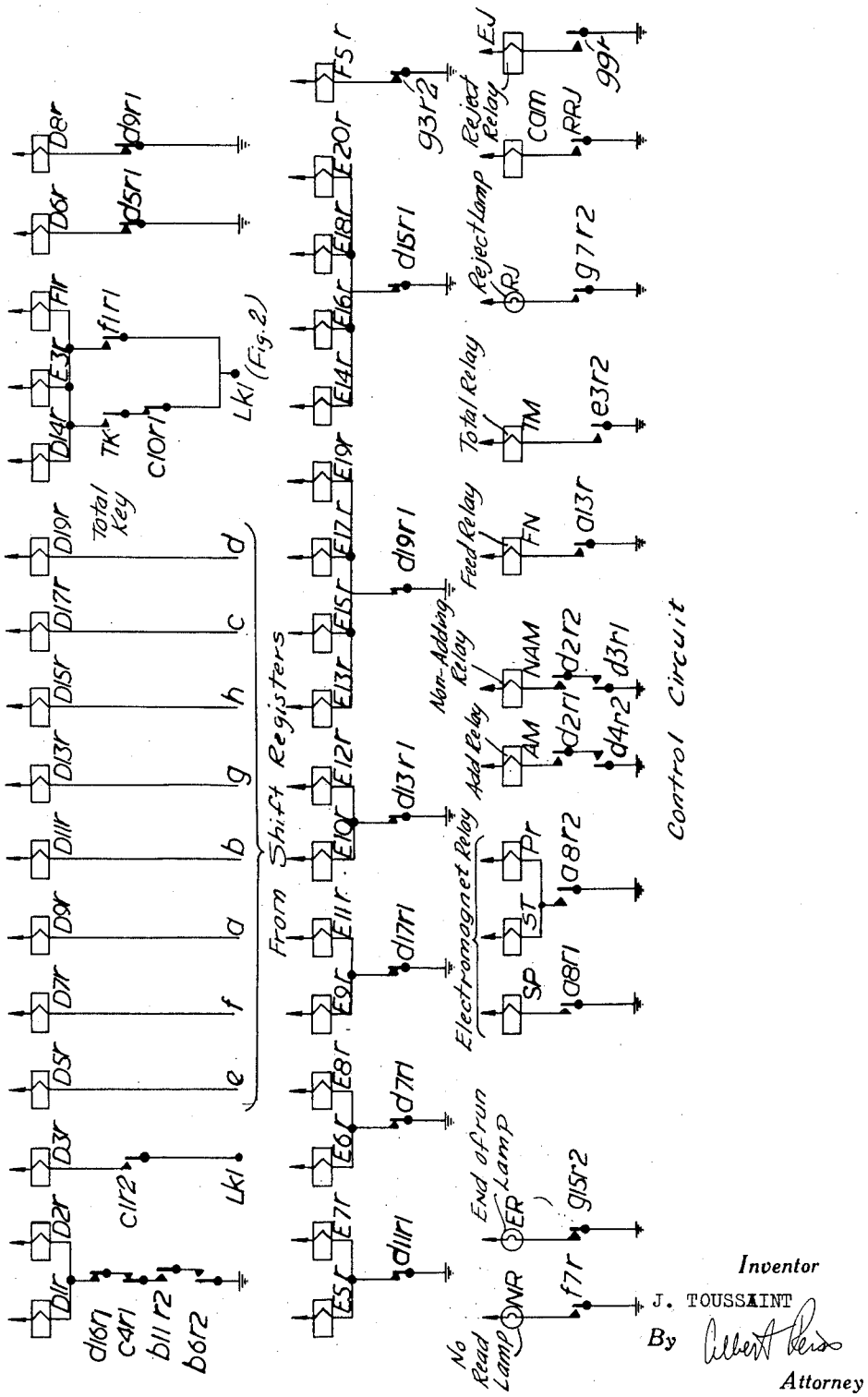
FIG. 3.



Inventor
J. TOUSSAINT
By Albert Reiss
Attorney

March 12, 1963 J. E. J. G. TOUSSAINT 3,081,446

DECODING AND PRINTING SYSTEM

Filed April 13, 1959 10 Sheets-Sheet 4

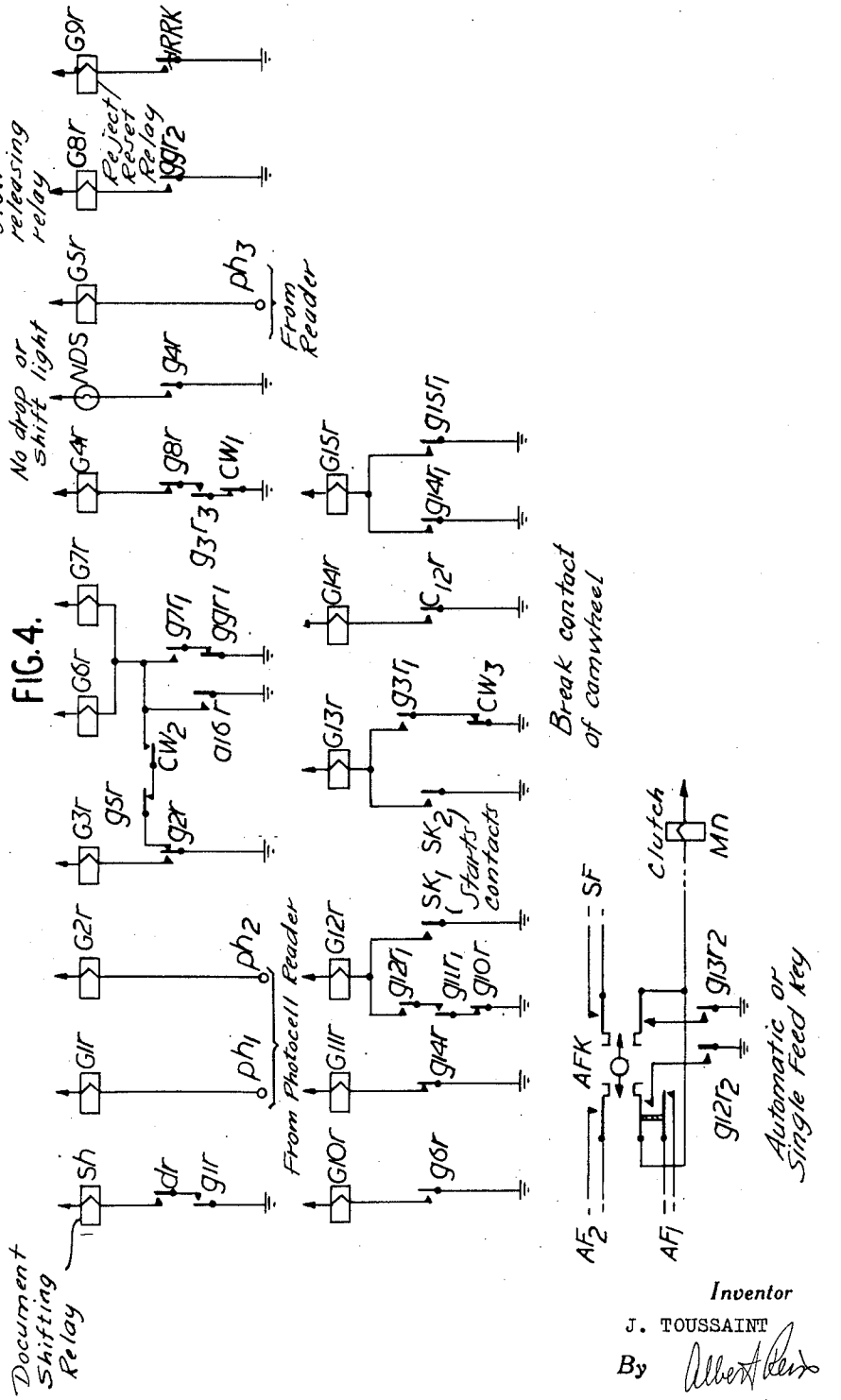


FIG. 4.

Inventor
J. TOUSSAINT
By Albert A. Reis
Attorney

March 12, 1963 J. E. J. G. TOUSSAINT 3,081,446

DECODING AND PRINTING SYSTEM

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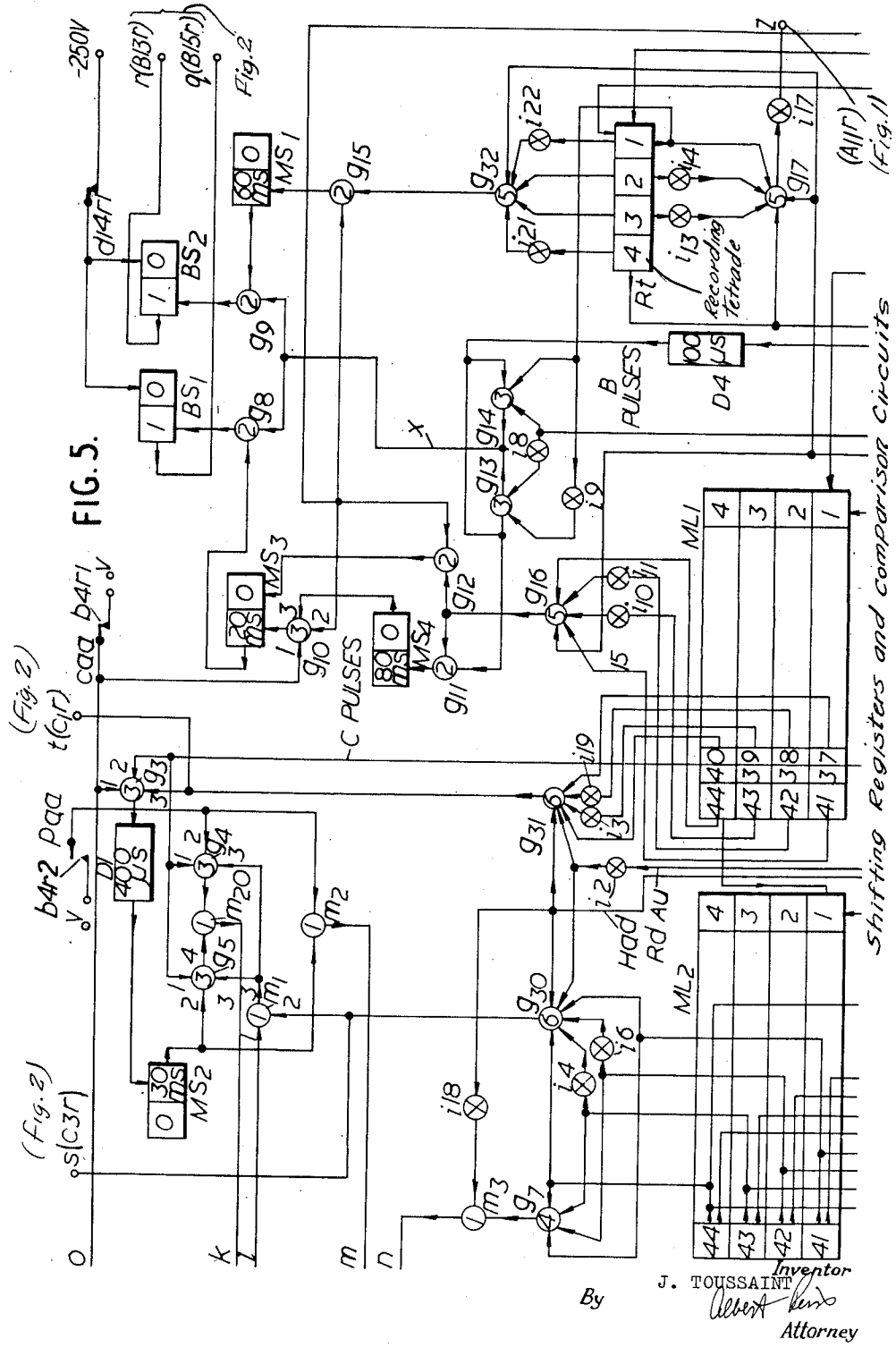

FIG. 5.

Inventor
J. TOUSSAINT
By
Attorney

March 12, 1963 J. E. J. G. TOUSSAINT 3,081,446

DECODING AND PRINTING SYSTEM

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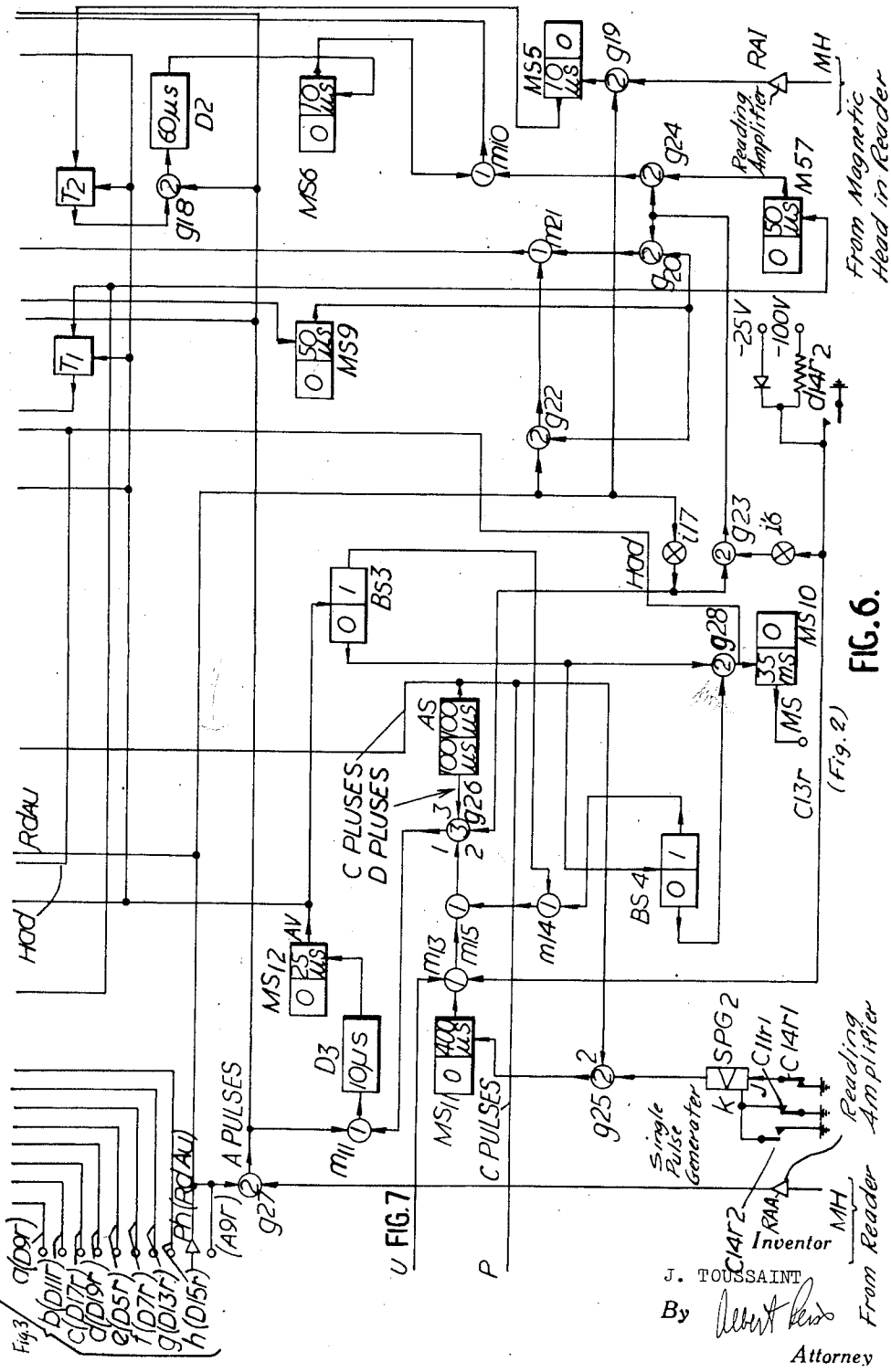

Inventor
J. TOUSSAINT
By
Attorney

March 12, 1963 J. E. J. G. TOUSSAINT 3,081,446

DECODING AND PRINTING SYSTEM

Filed April 13, 1959 10 Sheets-Sheet 7

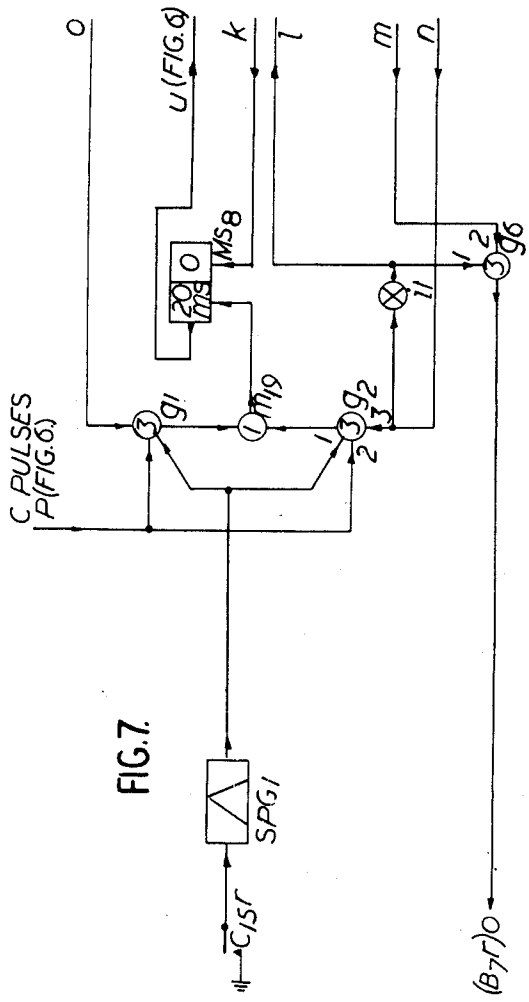

FIG. 7.

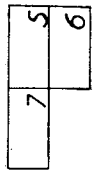

FIG. 11.

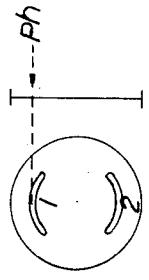

FIG. 10.

Inventor
J. TOUSSAINT
By Albert Peiso
Attorney

March 12, 1963 J. E. J. G. TOUSSAINT 3,081,446

DECODING AND PRINTING SYSTEM

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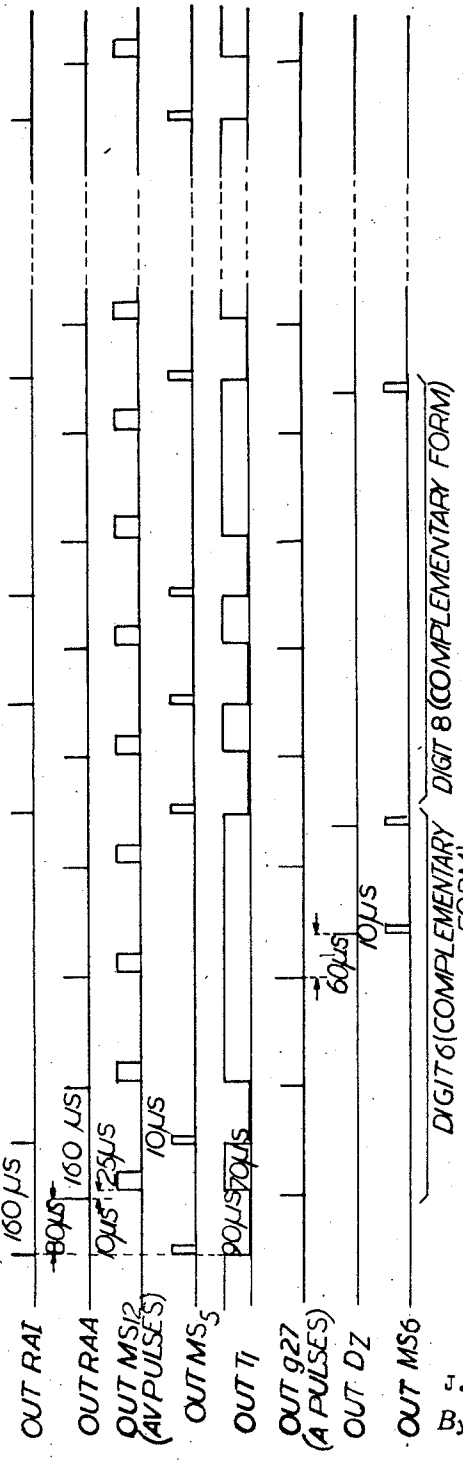
FIG.8.



Inventor
J. TOUSSAINT
By Albert Rens
Attorney

March 12, 1963 J. E. J. G. TOUSSAINT 3,081,446

DECODING AND PRINTING SYSTEM

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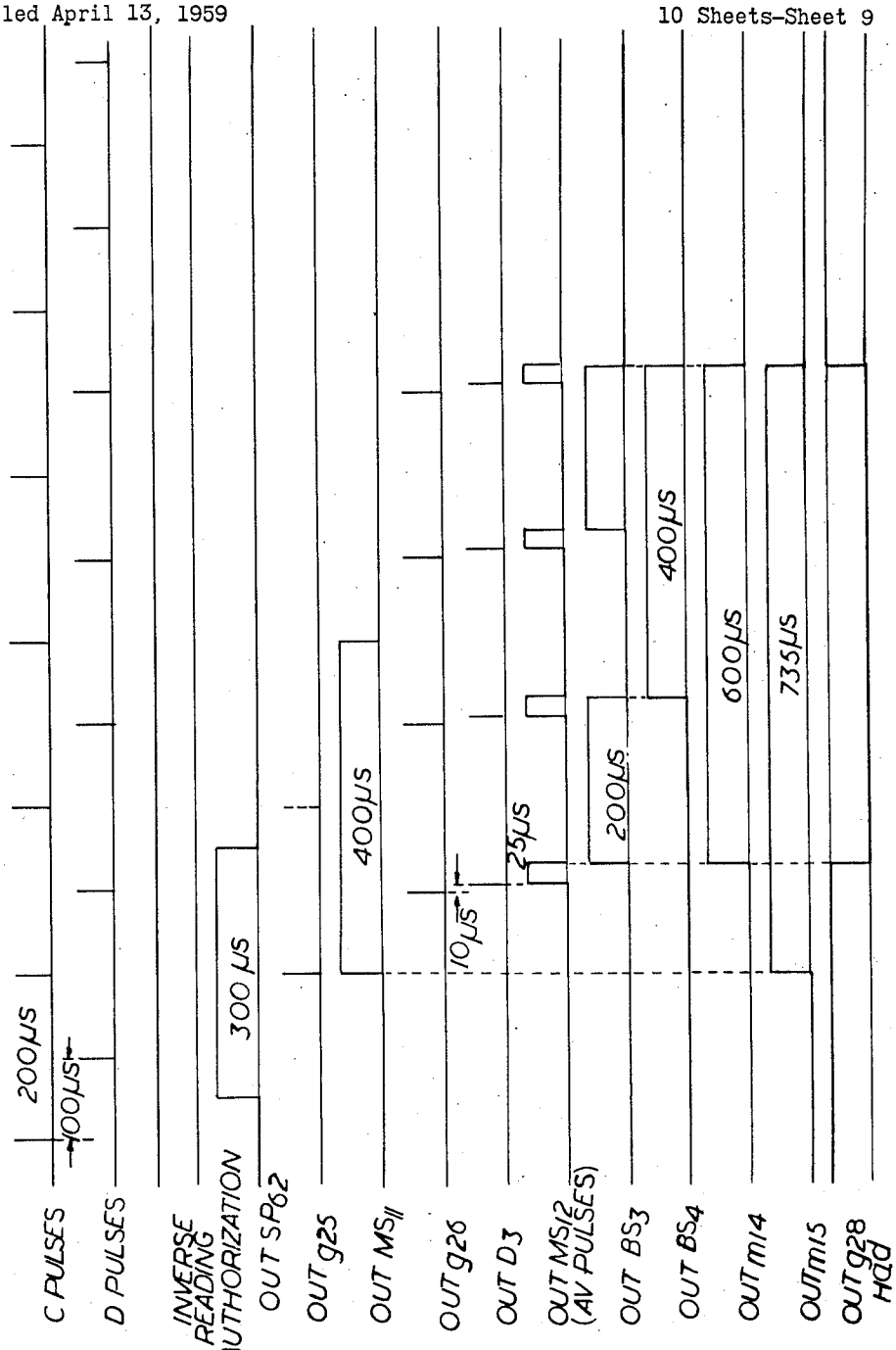
FIG.9.



Inventor

J. TOUSSAINT

By Albert Rossi

Attorney

March 12, 1963 J. E. J. G. TOUSSAINT 3,081,446

DECODING AND PRINTING SYSTEM

Filed April 13, 1959 10 Sheets-Sheet 10

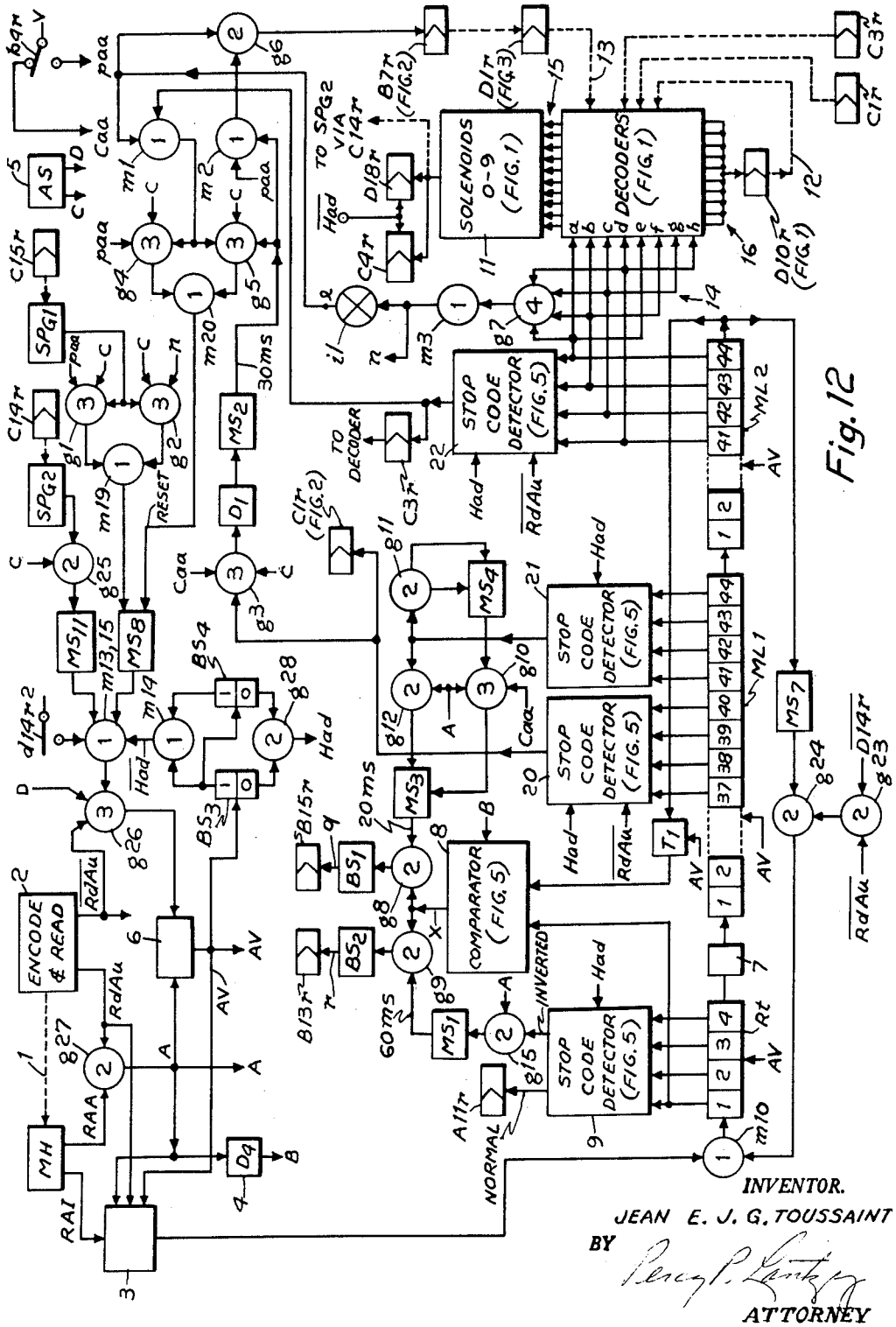


Fig. 12

United States Patent Office 3,081,446
Patented Mar. 12, 1963

3,081,446

DECODING AND PRINTING SYSTEM

Jean Emile Joseph Ghislain Toussaint, Antwerp, Belgium, assignor to International Standard Electric Corporation, New York, N.Y., a corporation of Delaware

Filed Apr. 13, 1959, Ser. No. 806,161
Claims priority, application Netherlands Apr. 16, 1958
11 Claims. (Cl. 340—172.5)

The invention relates to a decoding and printing system. Such a system may for example be required for the automatic processing of documents and data e.g. a system conceived for the automatic processing of bank cheques.

For each cheque arriving in a bank a plurality of operations have to be executed, and it may be advantageous to mechanize these operations as far as possible.

In the system disclosed in Belgian Patent No. 577,754, each cheque, which has to be processed, is first inserted in a document carrier, provided with a magnetic tape strip, on which the relevant cheque information, e.g. account number and amount, is inscribed.

The insertion operation is realized by means of a machine such as described in Belgian Patent No. 577,761, while the encoding operation is executed by a mechanism, such as disclosed in Belgian Patent No. 577,749, patent application No. 226,884, the above mentioned encoding and printing system controlling the encoding operation.

When the document carriers have thus been processed, they are classified, according to the issuing bank and the account number of the cheque, by means of a sorting machine of the type disclosed in the United States patent application Serial No. 805,800. The processed cheques are thus divided in at least two groups: incoming cheques, which are cheques of the bank itself, and outgoing cheques, which are the property of other banks.

The operations to be executed on these two groups of cheques are somewhat different, since the incoming cheques have to be processed in a bookkeeping machine, while the outgoing cheques have only to be decoded in order to make cheque listings and bundles.

The system in accordance with the present invention is particularly, but not exclusively, devoted to the processing of outgoing cheques, together with the control of their extraction out of their document carriers.

The extraction operation itself is described in Belgian Patent No. 577,767.

The principal object of the present invention is to provide an electrical and electronic control for such a machine and particularly for decoding and printing the information, which is encoded on the strip of magnetic tape that is fixed on the document carrier wherein the cheque is held.

It is advantageous to provide at least one storage device into which the whole information, read from the document carrier with the help of a reading mechanism, may be stored and from which the required decoding and printing operations may be carried out.

In accordance with a first characteristic of the invention, a system for decoding and printing information encoded on a magnetic record is characterised in, that said magnetic record appears on individual documents or on document carriers, e.g. a piece of magnetic tape affixed on a carrier enclosing a cheque, that said system includes first means for reading said encoded information, second means for transmitting the read information to a storage device, third means for transmitting the stored information to a decoding circuit, and fourth means, associated with said decoding circuit, for transmitting the

decoded information to a printer which is able to print this information.

It is advantageous to decode the information serially, or at any rate decimal digit by decimal digit, and to transmit these digits in turn to the printer, since a considerable amount of equipment is saved. Nevertheless, such an operation trades equipment for time.

Another object of the invention is to save time in printing serially by avoiding the printing of an account number, or other identifying information, whenever this is the same as the number of the preceding item.

In accordance with another characteristic of the invention, a decoding and printing system, as described above, is characterised in that it comprises a comparison circuit associated with said storage device for comparing said read information, or part thereof (e.g. the account number), with the corresponding part (e.g. the account number) of the information previously stored in said storage device.

When making listings of cheques it may be desired to have the possibility of taking the total of the amounts of a certain number of cheques e.g. of those provided with a same account number.

In accordance with another characteristic of the invention, a decoding and printing system, as described above, is characterized in that it includes an adding machine which enables the information or part thereof (e.g. the amount) to be stored in its totalizer.

The above mentioned and other objects and features of the invention will become more apparent and the invention itself will be best understood by referring to the following description of an embodiment taken in conjunction with the accompanying drawings in which:

FIGS. 1 to 7, the latter three assembled as shown on FIG. 11, constitute a complete circuit diagram of a detailed embodiment of the invention;

FIG. 8 is a timing chart of the reading operation;

FIG. 9 is a timing chart of the generation of a train of four advancing pulses;

FIG. 10 represents a disk, part of a reciprocating mechanism for displacing a magnetic head;

FIG. 11 shows how FIGS. 5 to 7 have to be assembled; and

FIG. 12 is a block diagram of the decoding and printing system of this invention.

A summary description of the detailed embodiment of the invention will first be given.

It is first assumed that the document carriers have previously been encoded and sorted by means of machines already mentioned above. The information encoded on a checque is constituted by an eight-digit account number, a two-digit sorting prefix which characterizes the type of cheque is constituted by an eight-digit account number, cheques, a one-digit sign of amount to indicate debit or credit for the bank, an eleven-digit amount, and a last digit or stop symbol which characterises the end of the multi-digit information. Also a three-digit so-called credit item, characterizing the number of cheques accompanied by a deposit ticket may be encoded on the document carrier. A deposit ticket is a ticket deposited by the owner of a bank account when he delivers a number of cheques to his bank to be added to his bank account. He thereon inscribes his own account number and the total of the amounts of said number of cheques. In what follows, the three-digit number of credit items will however be disregarded, such that the encoded information consists in 8+2+1+11+1=23 decimal digits, which are however serially encoded on a binary-coded decimal basis in the following order:

2-digit sorting prefix, 8-digit account number,

1-digit sign of amount, 11-digit amount and 1-digit stop symbol.

The binary 4-digit numbers allotted to the decimal digits correspond to the so-called Aiken code

0	0000	5	1011
1	0001	6	1100
2	0010	7	1101
3	0011	8	1110
4	0100	9	1111

Among the various advantages of the above code one finds that the 10 coded combinations form a closed group with respect to complementing i.e. inversion of the ones into zeros and vice versa.

The above mentioned information has first been encoded in accordance with the Aiken code and followed by a complete encoding in the inverse Aiken code i.e. with the ones changed into zeros and vice versa. This means that every so inversed decimal digit corresponds to another decimal digit which is merely the complement to 9 of the original decimal digit.

Since a special end code is required for positioning the information in the shift registers, this means that any of the six remaining 4-digit binary numbers which are not allotted to represent decimal digits may be used as the special end code, without any possibility of an inversed decimal digit becoming this end code.

Likewise, each full number including the end code is inverted to give the second representation and the inverted end code also cannot correspond to one of the decimal digits. The double serial encoding of each full number in normal and inverse form, the full inverse form following the full normal form, has the advantage that it is practically impossible for any error to remain undetected. This would require that if a fault causes a binary 1 to become a binary 0, some other fault should simultaneously transform the inverse 0 into a 1, and the chances of such complementary errors are too remote to be taken into account.

The stop symbol is the 4-digit binary number 0110. The 4-digit binary numbers 1111 and 0000 are respectively allotted to the + and — signs of amount.

The above mentioned presorted (in accordance with sorting prefix and account number) cheque carriers are delivered, one by one, to a so called reading position in a manner disclosed in the above mentioned Belgian Patent No. 577,761. The encoded information relative to a first arriving cheque is then read by a mechanism such as described in the Belgian Patent No. 577,749. Afterwards it is transmitted to an electronic storage device which may conveniently be a pattern shift register such as disclosed in the United States Patent No. 2,649,502 of A. Odell where each stage, adapted to store a binary bit, includes a cold cathode tube plus associated circuitry. Since it is desired to have the normal form of the information stored in the shift register or memory line after the reading operation is finished, and since this shift register is adapted to contain one form only, this information will be inverted before being transmitted to said lines. In this manner the complementary form is first stored in said shift registers, and, during the transmission of the normal form, said complementary form, now leaving the shift register, is continuously and serially compared (i.e. bit by bit) with said normal form entering this shift register by a comparison circuit associated with the shift register.

When no discrepancies are detected during this comparison, the information is transmitted digit by digit through a self-checking decoding circuit to an adding machine, and when no discrepancies are detected by this self-checking circuit, the information is printed by a printer which is a part of said adding machine.

A following document carrier is then transferred to the reading position and the information encoded on its tape is also read and serially stored in said shift register.

The complementary form of the information, the amount excepted, may be serially compared i.e. bit by bit with the corresponding information, relative to said first cheque, already stored in the shift register in normal form (i.e. in the case of the so called automatic feed).

If the compared informations are found to correspond, the compared information is prevented from being transmitted to said self-checking decoding circuit so that it cannot be printed. It is to be remarked that the amount is always transmitted to the adding machine and printed when no discrepancies are detected by said decoding circuit.

When during the comparison of the account numbers and sorting prefixes of two successive cheques, two compared bits are found to be different, the machine is stopped.

This is necessary since a plurality of operations have to be executed during this stop period as will be explained.

The machine is provided with a mechanical counter for counting the document carriers arriving in a so-called output position. Indeed, after having been processed in the above mentioned machine for extracting documents out of document carriers, the latter carriers are transferred to an output stage which is enabled to contain only a certain predetermined maximum amount of document carriers, e.g. 1000. It may however be desired to make bundles of the cheques (eventually only one cheque) which are provided with the same account number and to remove these bundles out of the output stage immediately after they have been formed. It is clear that in that case the counter has to be reset to its zero condition.

In case of automatic feed, the machine will be stopped after a difference between two compared bits is detected i.e. at a moment when at least the first bit of the first digit of the sorting prefix of the read cheque is stored in the shift registers. The new information of the new cheque having a different account number will nevertheless continue to be entered in complementary and in normal form in the shift registers.

It is now desired to know the total of the amounts of the cheques of such a bundle so as to be able to inscribe this total on a ticket associated with the bundle. Therefore a total key has been provided, so that the total made in the adding machine is allowed to be printed.

At the same time, the circuit which provides wiping-out pulses for the shift registers in case a discrepancy between the two forms of the same information is detected, will be actuated to wipe out the information of the new cheque which must be read again to permit printing of the new account number.

Summarizing, in case of automatic feed, the machine is stopped each time a different sorting prefix or account number is detected, and the total key has to be depressed during every stop period in order to be able to process a following cheque. Although this is exceptional, it may happen that all the cheques processed are known to be provided with a different account number. With the machine working, as explained above (automatic feed), it will be stopped after each cheque is processed, and during each stop period the total key has to be depressed.

This is naturally a waste of time and therefore the machine can be put in a so-called single-feed condition, whereby the account numbers of two successive cheques are not compared. Due to the latter fact, the shift registers must also not be cleared and the total key must not be depressed during each stop period. For enabling the cheques to be processed in automatic or single feed, the machine has been provided with a so-called automatic or single feed key. With the key in automatic feed position, the machine works as described above, while with the key in the single feed position, the total key need not be depressed in order to be able to process a following cheque.

From the reading station the read cheque is transferred to a position wherein it is extracted out of its document

carrier, and afterwards the latter is then transferred to an output stage.

A detailed description of a detailed embodiment of the present invention will now be given, hereby principally referring to the various figures and also to the above mentioned Belgian Patent No. 577,767.

Therein it is disclosed how a document carrier containing a cheque is transferred from a transverse conveyor, by which it is advanced, to a so-called input position situated on an edgewise conveyor by means of a drop mechanism such as described in the United States application, Serial No. 806,286, filed April 4, 1959, by G. X. Lens, et al.

When a document carrier is thus transferred to said input position, it may be brought to the adjacent, so called encoding position by means of an electromagnet controlled shifting wheel. The operation of this electromagnet Sh (FIG. 4) depends however on several conditions. Indeed it is only operated when simultaneously a document carrier is situated in the input position (contact dr closed) and when the make contact g_1r of the relay G_1r is closed.

The reading position is provided at its left and right top corners with a photocell Ph_1 and Ph_2 respectively near the entrance and the exit of said position. In its middle it is furthermore provided with a photocell Ph_3. The location of these photocells is not shown here but the corresponding signals appear on FIG. 4. The former two photocells Ph_1 and Ph_2 are prevented from receiving the light from their corresponding light source by a document carrier positioned in the reading stage, while the latter photocell Ph_3 is prevented from receiving the light of its light source by a document actually positioned in said document carrier. When the photocells Ph_1, Ph_2, Ph_3 are normally receiving the light from the corresponding light source, the relays G_1r, G_2r and G_5r are normally operated.

From the foregoing it is clear that when a document carrier is situated in the input position (dr closed) and when there is no document carrier positioned in the reading stage (G_1r operated), the shifting electromagnet Sh (FIG. 4) will be operated so as to transfer this document carrier to the reading stage.

If there is no document carrier positioned in the reading stage, the relay G_2r is thus operated, and by closing its make contact g_2r (FIG. 4), it energizes the relay G_3r. By opening its break contact g_3r_2, the latter removes the ground from the relay F_5r (FIG. 3), and by closing its make contact g_3r, it operates the relay G_4r as follows:

Battery, coil of relay G_4r, closed break contact g_8r of the relay G_8r, closed make contact g_3r_3, contact cw_1, closed by a camwheel (not shown), ground.

The relay G_4r lights the lamp "no drop or shift" NDS (FIG. 4) by closing its make contact g_4r, while it prevents, in a manner not shown, the operation of the mechanism located in the next or so called unjacketing position, described in detail in the above-mentioned Belgian Patent No. 577,767.

When there is a document carrier situated in the reading position without cheque in this carrier, then this is detected by the above mentioned photocell Ph_3, since the latter then continues to receive the light from the corresponding light source although the photocell Ph_2 is prevented from receiving the light from its corresponding light source.

In this manner the relays G_2r and G_5r are respectively released and operated such that the parallel connected relays G_6r and G_7r are operated as follows.

Battery, coils of relays G_6r, G_7r, make contact cw_2 closed by said camwheel (not shown), closed make contact g_5r, change-over contact g_2r in the position shown, ground.

These relays are locked through the closed make and break contacts g_7r_1 and g_9r_1 respectively. The relay $G_{10}r$ is then operated through the closed make contact g_6r, so that the eventually operated relay $G_{12}r$ (FIG. 4) is released, the relay $G_{11}r$ being normally operated. The reject lamp RJ (FIG. 3) is lighted by the closure of the contact g_7r_2 of the relay G_7r. By operating the reject reset key RRK the relay G_9r is operated and the relays G_6r, G_7r are thus released. By closing its make contact g_9r, the relay G_9r operates the reject electromagnet EJ. It further energizes the slow releasing relay G_8r when closing its contact g_9r_2.

The relay G_4r is prevented from being operated due to the opening of make contact g_8r, so that the no-drop-or-shift lamp is not lighted and the operation of the mechanism located in the above mentioned unjacketing position is not interrupted.

Relay $G_{12}r$ is unlocked by the operation of the relay $G_{14}r$, since the later releases the relay $G_{11}r$. It is also unlocked by the reject signal in a manner described above, since the relay $G_{10}r$ is then operated.

It is now assumed that a document carrier with a document inserted therein is positioned in the reading stage. Many indications have to be kept in memory. These memories are realized by relays which lock themselves to ground. As the reset of these relays may be necessary at different times, two fundamental locking grounds Lk_1 and Lk_2, which are removed at different times of a complete operation cycle, are used in the arrangement according to the present invention.

For starting the operations, a start key SK (not shown) is depressed, thereby closing its contacts SK_1, SK_2 (FIG. 4) and SK_3 (FIG. 1). By closing the contacts SK_1, SK_2, the relays $G_{12}r$ and $G_{13}r$ are operated. The former relay $G_{12}r$ is locked through the closed make contacts $g_{12}r_1$, $g_{11}r$ and through the closed break contact $g_{10}r$ of the unoperated relay $G_{10}r$. The latter relay $G_{13}r$ is locked through the closed make contact $g_{13}r_1$ and the closed break contact cw_3 of the camwheel (not shown).

Through their closed make contacts $g_{12}r_2$ and $g_{13}r_2$, the relays $G_{12}r$ and $G_{13}r$ each apply a ground connection to an associated contact of a so-called automatic or single feed key AFK, shown in (FIG. 4) in its neutral position. The latter key may be put from its neutral into one of its two active positions: automatic or single feed. In both cases the so called main clutch Mn is operated and the machine starts an automatic cycle. In the automatic feed position the contacts AF_1, AF_2 are closed, while the contact SF is opened, while in the single feed position, the contacts AF_1, AF_2 are opened and the contact SF is closed. It is now supposed that the key is put in its automatic feed position.

By closing the contact SK_3 (FIG. 1), when depressing the start key, the parallel relays A_1r, F_3r, C_9r, B_1r are operated as follows:

Battery, coils of relays A_1r, F_3r, C_9r, B_1r, closed contact SK_3 of key SK, closed break contacts $b_{16}r_1$, $b_{14}r_1$, $b_{13}r_1$, ground.

The relay A_1r operates the relays A_3r and A_4r (FIG. 1) by closing its make contacts a_1r_1 and a_1r_2 respectively, and the relay A_3r locks itself on a ground given through the closed break contact a_7r_1 and on a ground given through the closed make contact a_4r_1. The relay G_3r, being released in a manner described above, operates the relay F_5r through its closed break contact g_3r_2 (FIG. 3). By opening its break contact f_5r_1 the relay F_5r releases the normally operated relay F_2r (FIG. 1). However, due to the operation of F_3r, the relay F_2r (FIG. 1) is then again operated through the closed make contact f_3r.

The relays A_3r, F_2r and F_5r being operated, the parallel connected relays A_6r and A_8r (FIG. 1) are energized as follows:

Batteries, coils of relays A_6r, A_8r, closed make contacts f_2r_1, f_5r_2, a_3r_2, ground.

By respectively closing and opening its make and break contact a_6r_2 and a_6r_1, the relay A_6r discharges the capacitor C_1 which was, through the closed contacts a_6r_1, a_5r_1 and the coil of the relay $A_{16}r$ (FIG. 2), at nearly the complete battery potential, since the value of the resistance R_1 is high with respect to the value of the coil resistance of the relay $A_{16}r$. Although the removal of this battery, when opening the break contact a_6r_1, is sufficient to discharge the capacitor C_1, a ground is given by the closed make contact a_6r_2, so as to reduce the discharge time. During this time a resistance R'_1 is further connected in series with the capacitor C_1 in order to limit the discharge current on said contact a_6r_2. By respectively closing and opening its make and break contact a_8r_2 and a_8r_1, the relay A_8r energizes the electromagnets Pr, $St(a_8r_2)$ and releases electromagnet $Sp(a_8r_1)$, as shown in FIG. 3.

These electromagnets constitute parts of an encode and read mechanism, of the type mentioned above, which enables a reciprocating motion of a magnetic head which is normally uncoupled from a constantly rotating motor, since said so-called brake electromagnet Sp is normally operated. When it is desired, however, to couple the head to the motor for reciprocation, it is sufficient to release brake electromagnet Sp and to operate a coupling electromagnet St. In order to enable the reading of the magnetic tape strip, fixed on a document carrier, it is moreover necessary to press said magnetic tape between the magnetic head and a cushion. This cushion is therefore attached to the plunger armature of a pressure electromagnet Pr which is operated simultaneously with said coupling electromagnet St. As mentioned in the Belgian patent already referred to, the read mechanism comprises a synchronizing slotted disk which enables, due to its association with one or more photocells, the delivery of signals during well defined time intervals. For the present control system the disk is slotted as shown on FIG. 10, and it is associated with the photocell Ph. In this manner the length of a so-called reading authorization signal $RdAu$, is determined. Indeed, this authorization is given as long as the photocell Ph receives the light from a light source through one of said slots. Since the disk makes one rotation for two cyclic displacements of the magnetic head, two slots are provided.

By closing its make contact c_9r, (FIG. 1), the relay C_9r operates the relay $C_{10}r$ (FIG. 2) which is further locked in the following manner:

Battery, coil of relay $C_{10}r$, closed make contact $c_{10}r_2$, closed break contacts $c_{16}r_1$, c_7r_1 and c_8r_1, closed make contact $g_{11}r_1$, ground.

The operation of the relay $C_{10}r$ makes the total key TK inoperative (FIG. 3) by opening its break contact $c_{10}r_1$.

By closing its make contact b_1r, the relay B_1r (FIG. 1) operates the parallel connected relays B_2r and B_3r (FIG. 2) which are both locked through the closed make contact b_2r and the closed break contact b_5r. A constantly rotating motor being coupled to the encode and read mechanism as described above, reading authorization signal $RdAu$ is given when the above mentioned photocell Ph (FIG. 6 and 10) receives the light from a light source through one of the slots provided in said disk (FIG. 10).

In this manner the relay A_9r (FIG. 1) is operated, and by the closure of its make contact a_9r_2 and a_9r_3, respectively, the relays $A_{14}r$ (FIG. 2) and $A_{12}r$ (FIG. 1) are energized.

By closing its make contact $a_{14}r$, the relay $A_{14}r$ operates the relay $A_{16}r$ (FIG. 1). The break contact a_9r_1 being open, the capacitor C_2 (circuit of relay A_7r), previously charged through the winding of A_7r and slightly discharging through R_2, is now fully discharged through protecting resistor R'_2 during closure of the make contact $a_{16}r_2$.

As long as the stop symbol in normal form is not stored in the so called recording tetrad Rt (FIG. 5) the relay $A_{11}r$ (FIG. 1) is energized via the output Z (FIG. 5), as will be explained later. In that case the relay $A_{15}r$ (FIG. 2) is energized through the closed make contacts $a_{11}r_2$ and $a_{12}r_2$, and it is further locked through the closed break and make contacts b_5r and $a_{15}r_1$, respectively.

The above mentioned recording tetrad is a part of a chain of shift registers including the shift registers ML_1 and ML_2 (FIG. 5). It is constituted by four series-connected cold cathode tubes, while said shift registers are each formed by eleven consecutive tetrads so that they are adapted to store the sorting prefix, the account number, and the sign of amount on the one hand, and the amount of a cheque on the other.

From the foregoing it is easy to see that the read mechanism is kept running as long as the start key SK is depressed. Normally the start key will be released before the end of the reading operation, so that the brake electromagnet is operated at a convenient time sufficient to stop the read mechanism in a position such that the displaced magnetic head is in one of the limit positions of its reciprocating travel. It may however, happen that, at the moment the start key is released, the displaced magnetic head takes a position close to one of said limit positions. When starting the energization of the brake electromagnet at that moment, the read mechanism is not stopped when reaching one of said limit positions, since the brake electromagnet is unable to operate rapidly enough, but it continues to be displaced in an opposite direction, in view of the reciprocating motion used, whereby it is only stopped in a position between said two limit positions of its course. To stop the magnetic head in the right position in all cases a system has been provided which works as follows:

When the reading authorization is removed, the relay A_9r (FIG. 1) releases and energizes temporarily the relay A_7r during the charge of capacitor C_2. Two different cases may now be distinguished due to the fact that the start key may be released during said short operation time or not.

In the second case the relay A_3r releases as soon as the reading authorization is removed, i.e. when the relay A_7r is temporarily operated. Indeed, the relay A_3r was locked through the closed break contact a_7r_1. The relay A_3r being released, the relay A_8r also releases and operates the brake electromagnet Sp (FIG. 3) and the mechanism is stopped in the appropriate limit position.

In the first case the relay A_4r (FIG. 1) is locked through its own closed make contact a_4r_2 and the closed make contact a_7r_2. It thus keeps relay A_3r (FIG. 1) operated through its closed make contact a_3r_1 until the relay A_7r releases. At that moment the relay A_3r locks itself again through the closed break contact a_7r_1 for another new but ineffective cycle of the mechanism. The latter mechanism will then stop in appropriate position, as described above.

The reading authorization being given, the reading of the information encoded on the document carrier positioned in the reading stage may start. Since on the tape, the complementary form of the information follows the normal form, it will be transmitted to the shift registers after inversion so as to finally store the information in normal form.

In the Belgian Patent No. 255,754, already referred to, an information and a parallel synchronizing pulse track are encoded on the magnetic tape strip fixed on each document carrier and every binary digit encoded on the tape is followed at a half period distance by a reversal of magnetisation on that synchronizing pulse track. Furthermore it is to be remarked that a 1 corresponds to a change in magnetisation of the tape, while no change is made for a 0. The information and synchronizing pulse tracks are respectively read by the reading amplifiers RAI and RAA (FIG. 6) connected to the twin magnetic head MH.

Every magnetic saturation reversal on the information track read by the reading amplifier RAI triggers the monostable multivibrator MS_5 to obtain, through the

AND gate g_{19}, a clean pulse of 10 μs., the other input lead of g_{19} being activated by the reading authorization signal. The pulse produced by MS_5 is fed to a special stage T_2 of the shift registers designed to record this pulse. The state of the tube used in T_2 will then control the synchronizing pulses received through amplifier RAA from the master channel, and which lag by about half a period behind the eventual information pulses, so that these synchronizing pulses will actually produce pulses or not, in accordance with the respective absence or presence of an information pulse on the corresponding track. In this manner, the operation becomes independent, within one period, of the small phase shifts between the pulses on both tracks, since the pulses from the master channel will perform the double task of actually feeding the information to the shift registers as well as advancing the information pattern.

When reading the synchronizing pulse track, every magnetic reversal thereon delivers a pulse which is fed through AND gate g_{27}, the other input lead of which is already activated by the reading authorization signal. The pulse, thus obtained, hereafter called A pulse, is applied to an input lead of AND gate g_{18} (FIG. 6), the other input lead of which is conditioned by the state of tube T_2. This "A" pulse is thus only permitted to be fed through said gate when the latter tube was not fired i.e. when no information pulse, or, in other words, when a 0 was read from the tape. The resulting pulse is delayed by 60 μs. by delay unit D_2 and then applied to monostable multivibrator MS_6 which produces a clean pulse of 10 μs. which fires the tube **1** of the recording tetrad R*t* (FIG. 5) through the mixer m_{10}. In this way, the non firing of the tube T_2 corresponding to a 0 on the information track is made to record a 1 in the tetrad R*t* and vice versa.

The above mentioned A pulse is also applied through the mixer m_{11} (FIG. 6) and through a delay unit D_3 of 10 μs. to the monostable multivibrator MS_{12} which produces an advancing pulse of 25 μs. This advancing pulse is then simultaneously applied to the partial shift registers ML_1 and ML_2, to the recording tetrad R*t*, and to the special tube T_2, as well as to another tube T_1 the purpose of which will be explained later, and shifts the information previously stored therein. In this manner it is assured that when the pulse, eventually produced by the monostable multivibrator MS_6, arrives at the starter of the tube **1** of the recording tetrad, it will find the latter deionized. Simultaneously the tube T_2 is able to receive a following bit.

The above mentioned "A" pulse is moreover also applied through a delay element D_4 of 100 μs. to a comparison circuit, the output of the delay element D_4 being designated "B" pulses.

As mentioned above, two comparisons are executed when processing a cheque: a comparison between the account number of this cheque and the account number of the previously processed cheque, and a comparison between the normal and complementary forms of the same cheque. When a first cheque, e.g. of a group with a same account number, is processed, the first comparison is naturally not possible and is not made.

Therefore it is now supposed that a cheque has previously been processed and that the normal form of the information recorded thereon is stored in the shift registers ML_1 and ML_2.

The stop symbol 0110 is thus stored in the recording tetrad R*t*. In a manner described above the normal form of the incoming read cheque is now transmitted in complementary form to the recording tetrad R*t*.

A comparison is now made between the normal form of the information, the amount excepted, of the previously processed cheque, stored in the shift registers ML_1 and ML_2, and the complementary form of the corresponding information read from the incoming cheque now being processed. In order to permit this comparison, the last tube **44** of the shift register ML_2 (FIG. 5) is electrically coupled with an auxiliary tube T_1, designed for memorizing the state of said last tube. Indeed, at the end of the advancing pulse shifting the information from the shift register ML_2, the tube T_1 will eventually be fired. This happens when the tube **44** was found to be fired when the advancing pulse was applied thereon, i.e. when a 1 was stored therein. Since a 1 read from the tape of the actual processed cheque, does not fire the tube **1** of the tetrad R*t*, as explained above, it is thus clear that, when the information of the first and second cheque correspond, the tube **1** of Rt and the tube T_1 will be in opposite states of conductivity.

The output leads of these tubes constitute the input leads of the AND gate g_{14} (FIG. 5). The signals appearing on these leads are furthermore inverted by inverters i_8 and i_9 and applied to the AND gate g_{13}. The above mentioned 100 μs. delayed "A" pulse, hereafter called "B" pulse, is applied on said gates g_{13} and g_{14}. Since it arrives 100 μs. after the "A" pulse one ensures that the tubes T_2 and **1** of R*t* are in the stable state when the comparison pulse is applied to these gates g_{13} and g_{14}. Thus, it is easy to see that, only in case of non-conformity of the information, stored in the register and read from the tape, an output signal will appear at the common output lead *x* of the gates g_{13} and g_{14}.

The start key SK need only be operated for the first processed cheque when the automatic or single feed key AFK is in its automatic feed position, as was assumed. In this manner the relay B_4r is already released when processing the following cheques. A so-called account number authorization (*caa*) is then given by the closed break contact b_4r_1 (FIG 5). The first arriving "A" pulse is then permitted to be fed through the AND gate g_{10} to the long timing monostable multivibrator MS_3 which delivers a signal during 20 ms. Indeed the input lead **3** of the gate g_{10} is activated, due to the monostable multivibrator MS_4 being in its stable condition.

As mentioned above, when a difference is detected during the comparison, a signal appears at the output lead *x* of gates g_{13} and g_{14}. Due to the operation of the monostable multivibrator MS_3, it is then fed through the AND gate g_8 to the bistable multivibrator BS_1 which therefore is triggered. Its output signal then operates the relay $B_{15}r$ (FIG. 2).

It is to be remarked that, if the automatic or single feed key had been put in its single feed position, the relay B_4r would have been operated for each processed cheque due to the depression of the start key. In this manner the break contacts b_4r_1 would be open and the comparison now contemplated would be ineffective. From this it is clear that it is necessary to depress the start key SK when the automatic or single feed key is in the single feed position before processing a cheque.

Returning now to the automatic processing, the relay $B_{15}r$ (FIG. 2) operates the relay $B_{12}r$ when closing its make contact $b_{15}r_1$. The relay $B_{12}r$ then operates the parallel connected relays C_2r and C_3r (FIG. 2) through its closed make contact $b_{12}r_2$, while it energizes temporarily the relay $C_{12}r$ (FIG. 2) during the charge of the capacitor C_4, the resistance R_4 being too large to permit $C_{12}r$ to remain operated. By closing its make contact $c_{12}r$ the relay $C_{12}r$ operates temporarily the relay $G_{14}r$ (FIG. 4) which releases $G_{11}r$ by opening its break contcat $G_{14}r$. The latter relay $G_{11}r$ further releases the relay $G_{12}r$ by opening its make contact $g_{11}r$, while it brings a ground on the contact c_8r_1 (FIG. 2). Due to the opening of the make contact $g_{13}r_2$, the automatic cycling of the machine is interrupted, *Mn* (FIG. 4) being released. By closing its make contact $g_{14}r_1$ the relay $G_{14}r$ furthermore operates the relay $G_{15}r$, which then lights the so-called "end of run" lamp ER (FIG. 3) when closing its contact $g_{15}r_2$. The relay $G_{15}r$ remains locked through its closed make contact $g_{15}r_1$. The break contact c_2r of the relay C_2r being open, the paralleled relays B_9r, $B_{11}r$ and $B_{16}r$ (FIG. 2)

cannot be operated, so that no digit can be entered into the adding machine, as will be explained later.

The information leaving the tetrad R*t* (FIG. 5) is transmitted to the shift register ML_1 (FIG. 5) by means of the monostable multivibrator MS_9 (FIG. 6) acting as buffer circuit which is triggered each time an advancing pulse deionizes the tube 4 of the tetrad RT, i.e. when the latter tube was previously fired. The pulse of 50 μs. is then fed through the AND gate g_{22} (FIG. 6) the other input lead of which is activated by the reading authorization signal, and the mixer m_{21} (FIG. 6) to the tube **1** of the shift register ML_1 which is then fired. Due to MS_9 being in its stable condition, except only when triggered from stage 4 of R*t*, gate g_{22} cannot allow the passage of any undesired signals.

The comparison between the information, the amount excepted, is finished when the normal form of the stop symbol of the previously stored information is situated in the tubes 41 to 44 of the shift register ML_1. Indeed, the sorting prefix, the account number, and the sign of amount, necessitate 2+8+1=11 tetrads, and the 11 digits of the amount of the previous cheque are now stored in ML_2 ready to go out to T_1, while ML_1 now stores the beginning of the information of the new cheque up to the sign of amount stored in complementary form in R*t*. The signals appearing at these tubes 41 to 44 are applied on the AND gate g_{16}, those of the tubes 42 and 43 being previously inverted by inverters i_{11} and i_{10}, respectively. A supplementary so-called "Had" signal is also applied to the gate g_{16}. As this signal is only high when a complete decimal digit is entered in the shift registers, as will be explained later, the output lead of the gate g_{16} is accordingly activated only when the actual stop symbol is stored in tubes 41 to 44. This takes care of false stop symbols produced by the end of a digit and the start-of the next. Consequently the common input lead of the AND gates g_{11} and g_{12} is also activated. Immediately after the advancing pulse which led to g_{11} and g_{12} becoming conductive, the corresponding following "B" pulse will be the last to eventually pass g_3 since it will now pass through g_{11} to trigger the monostable multivibrator MS_4 for 80 msecs. and block gate g_{10}. Hence, the following "A" pulses for the digits of the amount will be prevented from passing through g_{10}, and the first of these will instead pass through g_{12} to reset MS_3 to its stable condition and therefore block g_8.

The advancing pulses being still applied to the shift registers, the information of the read cheque continues to be serially stored in these registers. Its complementary form is completely transmitted therein when the complementary form of the stop symbol (1001) appears in the tetrad R*t*, and thus the first recording of the information pertaining to the new cheque has now been read.

The output signals of the tubes **1**, 4, 2, 3 of the latter tetrad R*t* are applied to the AND gate g_{22}, the first two after having been inverted by the inverters i_{22} and i_{21}, respectively, together with the above mentioned "Had" signal. The latter signal is present only when there is a complete digit registered in the tetrad R*t*.

When the complementary form of the stop symbol (1001) is stored in the tetrad, it is easy to see that the monostable multivibrator MS_1, will be put in its unstable condition by the following "A" pulse passing through gate g_{15}, authorized by gate g_{32}. Monostable multivibrator MS_1 delivers a signal during 60 ms., thus activating the corresponding input lead of the gate g_9 during the same time.

After the complementary form of the read cheque is thus stored in the shift registers, its normal form is entered therein. In an analogous manner, as described above with regard to the comparison of the account numbers, the normal form of the information of the cheque is then compared with the corresponding complementary form of this same cheque by the same comparison circuit. When a discrepancy is detected, i.e. when the output lead *x* of the gates g_{13} and g_{14} becomes activated, this signal is applied through the AND gate g_9 to the bistable multivibrator BS_2 which is thus triggered. The resulting output signal then operates the relay $B_{13}r$ (FIG. 2). By closing its make contact $b_{13}r_2$, the relay $B_{13}r$ operates the parallel connected relays $B_{10}r$, F_7r, $C_{16}r$ and $D_{16}r$ (FIG. 2) which are then locked through the closed make contact $d_{16}r_2$. By closing its make contact f_7r, the relay F_7r lights the so-called "no read" lamp NR (FIG. 3). By closing its make contact $b_{10}r_1$, the relay $B_{10}r$ provides an additional operating circuit for relay $A_{12}r$ which was already operated through make contact a_9r_3 due to the operation of relay A_9r at the beginning of the reading authorization.

By closing its make contact $b_{10}r_2$, the relay $B_{10}r$ operates the parallel connected relays C_2r and C_8r. The break contact C_8r being open the locking circuit of the relay $C_{16}r$ is opened, this relay releases, and the total key TK (FIG. 3) is made effective.

At the end of the reading authorization, and as explained above, relay A_9r releases, followed by the release of relays $A_{12}r$, $A_{14}r$ as well as the temporary operation of relay A_7r, the release of relay A_9r, and in turn of relay A_6r. The reading operation is finished when the normal form of the stop symbol is stored in the tetrad R*t*. The output loads of the tubes of this tetrad constitute input leads of the AND gate g_{17}, the signals appearing at the tubes 2 and 3 being previously inverted by the inverters i_{14} and i_{13} respectively. A supplementary signal, the above mentioned "Had" signal, is also applied to the gate g_{17}. If the stop symbol is stored in the tetrad, the output lead of the gate g_{17} is activated since the "Had" signal is high. As it is applied to the coil of the relay $A_{11}r$ after having passed through the inverter i_{17}, the latter relay $A_{11}r$ is released.

In the case of a discrepancy having been found while comparing the two forms of the information, relay $A_{12}r$ is still operated, as mentioned above (contact $b_{10}r_1$), whereby relay A_5r cannot be operated. Hence, upon the release of relay A_6r, relay $A_{16}r$ will be temporarily operated while condenser C_1 is charged.

When closing its make contact $a_{16}r$ the parallel connected relays G_6r and G_7r are then operated and locked through make contact g_7r_1, and the reject lamp RJ is lighted through make contact g_7r_2. This will cause the operator to depress the key RRK (FIG. 4).

On the contrary, when no discrepancy has been found, the relay $A_{16}r$ cannot be operated at the end of the reading operation since, although the relay A_6r is then released, the relay A_5r is operated before this release.

Indeed, the release of relay A_6r requires, starting from the release of relay A_9r, the operation of relay A_7r and the release of the relay A_3r, while the operation of the relay A_5r only requires, starting from the release of relay A_9r, the release of relay $A_{12}r$.

The relay A_5r (FIG. 1) is then operated as follows:

Ground, closed break contacts $a_{12}r_1$, $a_{11}r_1$, closed make contact $a_{15}r_2$, coil of the relay A_5r, battery.

The relay $D_{20}r$ (FIG. 2) is then temporarily operated during the charge time of capacitor C_1 through the closed make and break contact a_5r_2 and a_6r_1 respectively. By closing its make contact $d_{20}r$ and the relay C_2r being unenergized since no discrepancies were previously detected, the parallel connected relays B_9r, $B_{11}r$ and $B_{16}r$ (FIG. 2) are operated through the closed break contact c_9r. By opening its break contact $b_{16}r_1$, the relay $B_{16}r$ makes the start key SK ineffective, while by closing its make contact $b_{16}r_2$, it operates the relay $B_{14}r$ (FIG. 2) which locks itself through its contact $b_{14}r_2$. By closing its contact b_9r, the relay B_9r locks the operated and parallel connected relays B_9r, $B_{11}r$ and $B_{16}r$ to ground through the closed break contact b_5r. By closing its make contact $b_{11}r_1$, the relay $B_{11}r$ energizes the relay $C_{15}r$ (FIG. 2) through the closed break contact c_5r.

By closing its make contact $c_{15}r$, the relay $C_{15}r$ applies an impulse to the single pulse generator SPG_1 (FIG. 7). This single pulse generator is designed to produce a single signal of 300 microseconds which cannot be affected by eventual contact vibrations of relay $C_{15}r$ during the period of this signal. It activates a common input lead of the AND gates g_1 and g_2. Before describing the effect of this signal, the production of local pulses of 5 kc./s. will be described.

The system is provided with a stable multivibrator A_S (FIG. 6) with built-in output differentiators, which produces a first series of pulses, called "C" pulses, at 200 μs. intervals, and an identical series of D pulses with the same frequency but phase shifted by a half period of 100 μs. The "C" pulse are continuously applied to the input lead of the AND gates g_1, g_2 (FIG. 7), g_3, g_4, g_5 (FIG. 5) and g_{25} (FIG. 6), while the D pulses are applied to the AND gate g_{26}.

A distinction now has to be made between cheques processed one by one with the automatic or single feed key in the single feed position, including the first cheque processed with the key in automatic feed position, and the second, third . . . cheques processed with the key in the automatic feed position. Indeed, in the first case, the complete information stored in the shift registers has to be transmitted to the adding machine, while in the second case, only the amount has to be transmitted therein.

As already mentioned above, in the first case the relay B_4r is operated, and in the second case it is released.

It is now assumed that the relay B_4r is operated. By closing its make contact b_4r_2, a so called print account number (*paa*) signal is applied to the gate g_4 and further through the mixer m_2 to the input lead 2 of the AND gate g_6 (FIG. 7).

Although the account number has to be printed in this case, the eventual non significant zeros of this account number, when it has less digits than the maximum number, need not be printed, and thus they do not have to be transmitted to the adding machine. The system described has been adapted for realizing this.

Suppose that an account number provided with at least one non-significant zero digit is stored in the shift registers. Thus a zero as highest significant digit is stored in the last tetrad of the shift register ML_2 (tubes 41 to 44). The output lead of the AND gate g_7 is activated, and this signal is applied through the mixer m_3 to the gate g_2. Since both the input leads 1 and 3 of the gate g_2 are thus activated, while the signal pulse lasts, the first arriving C pulse is able to trigger the monostable multivibrator MS_8 through the mixer m_{19}. This monostable multivibrator delivers a high signal during 20 ms. This signal is fed through the mixers m_{13} and m_{15} in cascade to the input lead 1 of the AND gate g_{26}. Since the input lead 2 of this gate g_{26} is activated, the inverse signal of the reading authorization signal being applied thereto, "D" pulses are permitted to be fed through the gate g_{26}, the mixer m_{11}, and the delay element D_3 of 10 μs. to the monostable multivibrator MS_{12} which produces advancing pulses of 25 μs.

These locally produced advancing pulses are applied to all the shift registers, such that the first zero digit and eventually the following zero digits of the account number are shifted out of the register ML_2. At the moment the first decimal digit different from zero is stored in the last tetrad, the generation of advancing pulses is stopped.

At the moment the first binary 1 is recorded in stage 41, gate g_7 will in fact no longer deliver a signal, but the output of inverter i_{18} constituting the inverse "Had" signal, still provides an activating signal through mixer m_3, until the 4 binary digits of the first account number digit, distinct from 0, are stored in stages 41 to 44. Indeed, at that moment, the output lead n of the mixer m_3 is deactivated. This signal is applied to the inverter i_1 (FIG. 7) and further fed through the mixer m_1 to the gate g_4, the other input lead of which is activated due to the above mentioned (*paa*) signal. In this manner the output lead of gate g_4 is activated and a signal is fed through the mixer m_{20} and lead k to the monostable multivibrator MS_8 (FIG. 7) which is thus reset in its stable condition, so that the generation of advancing pulses is stopped.

Since a complete decimal digit different from zero is now stored in the tetrad 41–44 of ML_2, the output lead of the gate g_6 is activated. Indeed, the inverted (i_1) output signal of gate g_7 is applied thereto together with the (*paa*) signal (m_2).

In this manner the relay B_7r (FIG. 2) is operated. The operation of this relay indicates that all the digits of the account number still stored in the shift register ML_2 may be transmitted to the adding machine.

The relay $A_{10}r$ (FIG. 1) being released at the end of the reading operation, the parallel connected relays B_6r and B_8r are then energized as follows:

Battery, coils of the relays B_6r, B_8r, closed make contact b_7r_2, closed break contact $a_{10}r_1$ ground.

Both relays B_6r and B_8r are then locked through the closed break and make contacts b_3r_1 and b_8r_2, respectively. These relays thus keep into memory the operation of relay B_6r.

As mentioned above, the parallel connected relays $B_{15}r$, B_9r and $B_{11}r$ are operated, so that when the make contact b_6r is closed by the operation of make contact B_7r of relay B_7r, the parallel connected relays D_1r, D_2r (FIG. 3) are operated when no faults were previously detected, as follows:

Ground, closed make contacts b_6r_2 and $b_{11}r_2$, closed break contacts c_4r_1, $d_{16}r_1$, coils of relays D_1r, D_2r, battery.

The digit stored in the last tetrad 41—44 of the shift register ML_2 is now set up in the adding machine by means of a self-checking decoding circuit. The adding machine is provided with a single series of ten digit solenoids (0 to 9) and with a series of print bars corresponding to the different digits that have to be printed after having been successively set up. Each of said solenoids is able to actuate a so-called stop member, and ten such stop members are provided per print bar. The adding machine is moreoevr provided with a so-called distribution bar which may be placed in a position corresponding to the rank of the digit to be printed i.e. corresponding to a print bar. It has naturally to be displaced by one stop each time a solenoid is operated. In brief, the working of the adding machine is as follows. Suppose that the number 13 has to be printed. The energization of the digit solenoid 1, by depressing the 1 key, actuates the stop member 1 of a first column of such stop members associated with a first print bar. The energization of the digit solenoid 3, when depressing the 3 key, shifts the distribution bar to the following position, corresponding with a second print bar and a second column of stop members of which the third one is now actuated. Each time a digit solenoid is energized, a so-called "make-digit" contact MDC (FIG. 2) is closed together with a so-called individual top contact m' (FIG. 2).

When all the digits of the information to be printed, e.g. the account number, are set up in the adding machine, all the print bars are released and arrested in a position corresponding to the previously actuated stop member. In this manner the digit characters, corresponding to the operated digit solenoids, are brought in front of the hammers of a printing device, so that they may easily be printed.

The adding machine is naturally provided with a totalizer such that e.g. an amount set up in the adding machine may be added to the previously obtained total of amounts.

It is further clear that, although the information is set up in the adding machine, said adding operation does not always have to be executed e.g. for an account number. Therefore, a so called "add" and "non-add" electromag-

net have been provided, which when operated respectively allow and disable the adding operation.

It is now assumed that e.g. the digit 8 (1110), stored in the last tetrad of the shift register ML_2, has to be printed. A direct connection has been provided between the output leads a to h of the tubes 41 to 44, two leads, such as a and e, being provided from each stage of this last tetrad and the relays D_9r, $D_{11}r$, $D_{17}r$, $D_{19}r$, D_5r, D_7r, $D_{13}r$, $D_{15}r$ (FIG. 3). Since a high signal appears only on the leads d and h, only the relays $D_{19}r$ and $D_{15}r$ are operated, and the other relays, previously operated when zeros were registered in all four stages, are released.

By opening the break contacts $d_{19}r_1$ and $d_{15}r_1$, the operated relays $D_{19}r$ and $D_{15}r$ respectively release the parallel connected relays $E_{13}r$, $E_{15}r$, $E_{17}r$, $E_{19}r$ and $E_{14}r$, $E_{16}r$, $E_{18}r$, $E_{20}r$ (FIG. 3). In this manner the following circuits are closed for the adding machine digit solenoid 8 (FIG. 1).

Battery, solenoid 8, closed break contact $e_{19}r_1$, closed make contacts $e_{11}r_2$, e_7r_2, d_8r_2.

The following circuit is furthermore closed for the relay $D_{10}r$ (FIG. 1):

Battery, coil of relay $D_{10}r$, closed make contacts d_6r_2, e_8r_2, $e_{12}r_2$, closed break contacts $e_{20}r_1$, $e_{19}r_1$, closed make contacts $e_{11}r_2$, e_7r_2, d_8r_2.

The relay D_1r has however been operated in a manner described above, so that a common ground Lk_1 is simultaneously given to the relay $D_{10}r$ and the solenoid 8 through the closed make contact d_1r and the closed break contacts c_1r_1 and c_3r_1 when no discrepancies were previously detected.

It is easy to seen that when the same information transmitted on the one hand to the relays D_9r, $D_{11}r$, $D_{17}r$, $D_{19}r$ and on the other hand to the relays D_5r, D_7r, $D_{13}r$, $D_{15}r$ does not correspond the relay $D_{10}r$ will not be operated. Its operation thus gives an indication about the correct setting up of digits in the adding machine. In other words, two sets of four relays are used, and whenever a relay operates in one set, the non-operation of its twin in the other set will prevent the operation of $D_{10}r$, whereby full safety against failure of a relay is ensured. By closing its make contact $d_{10}r$ the relay $D_{10}r$ operates the relay $D_{12}r$.

The corresponding stop member 8 is then actuated by the operated digit solenoid 8, which also closes one ($m'8$) of the above mentioned and parallel connected top contacts (m'_0–m'_9 on FIG. 2). In this manner the parallel connected relays C_4r and $D_{18}r$ are operated (FIG. 2) and locked through the closed break and make contacts $c_{13}r_2$ and c_4r_2, respectively. As will be explained further, the relay $C_{13}r$ is operated only when four advancing pulses are transmitted to the shift registers.

With the assumption that no discrepancy was detected by the decoding circuit, the ground given by the closed make contact $d_{18}r$ cannot operate the parallel connected relays $B_{10}r$, F_7r, $C_{16}r$, $D_{16}r$ (FIG. 2).

On the contrary when a discrepancy is detected by this self-checking decoding circuit, the relay $D_{10}r$ is not operated and when the relay $D_{18}r$ is operated in a manner described above, the parallel relays $B_{10}r$, F_7r, $C_{16}r$ and $D_{16}r$ (FIG. 2) are energized through the closed make and break contacts $d_{18}r$ and $d_{12}r_1$, respectively. By the closure of the contact $d_{16}r_2$ these relays are locked, while by the opening of the closed break contact $d_{16}r_1$, the operating circuit for the relay D_1r and D_2r is opened. These relays thus release, and so digits solenoids can be energized, the make contact d_1r being opened.

In a manner described above, the machine is then stopped and the "no-read" lamp NR is lighted. The total key is further rendered effective, the relay $C_{10}r$ being released. The operator may then depress this key, which, in a manner which will be described later, will cause the information to be wiped out from the register.

Assuming there is no fault, as mentioned above, when a digit is entered into the adding machine, the make digit contact MDC is closed. Thus the relay $C_{11}r$ (FIG. 2) is operated, and by closing its make contact $c_{11}r_2$ the latter relay energizes the relay $C_{14}r$.

Whereas the single pulse generator SPG_1 (FIG. 7) may include an input cold cathode tube which is fired by the application of ground, produces an output anode pulse to drive an output monostable circuit, and is deionized automatically by a time constant circuit in its anode circuit, in SPG_2 (FIG. 6), said cold cathode tube remains ionized and may only be deionized by opening its cathode lead (conductor k). Indeed, as long as the tube is fired and even afterwards when its anode is still low enough, contact vibrations cannot ionize it, but if these may persist for an unduly long time as may be the case for SPG_2, the time constant may have to be so large that it may harm the desired rapidity of operation in keying the digits. Hence, for SPG_2 a positive external control is preferred to determine when immunity to input signals is to cease.

Normally the cold cathode tube, part of the single pulse generator SPG_2, may be ionized, and when the break contact $c_{11}r_1$ is opened, due to the operation of relay $C_{11}r$, the cathode circuit k of said tube is opened and the latter tube is deionized.

The subsequent opening of the break contact $c_{14}r_1$ remains without effect. The closure of the make contact $c_{14}r_2$ again connects the cathode lead k to ground.

When the contact MDC is opened again, the relay $C_{11}r$ and afterwards the relay $C_{14}r$ are released, so that a supplementary ground is given to lead k during the time interval comprised between the release of $C_{11}r$ and $C_{14}r$. When contact $c_{14}r_2$ is opened, only the ground of $c_{11}r_1$ is connected to the cathode lead k. When the break contact $c_{14}r_1$ then closes, said tube is ionized, thus producing a pulse which is applied to the monostable circuit part of said single pulse generator SPG_2, so that the input lead 1 of the AND gate g_{25} is activated for 300 μs.

Principally referring to FIG. 8, the generation of a series of exactly four advancing pulses will now be described. This series is required to shift the digit stored in the last tetrad of the shift register ML_2 and only this digit.

The input lead 2 of the gate g_{25} being activated during 300 μs., at least one, and at most two, "C" pulses of 200 μs. period are permitted to be fed through this gate. The first of them is applied to the monostable multivibrator MS_{11} which is triggered and activates during 400 μs. the input lead of the gate g_{26} through the mixers m_{13} and m_{15}, so that at least one D pulse is applied through the gate g_{26}, the mixer m_{11}, and the delay element D_3 of 10 μs. to the monostable multivibrator MS_{12} which produces advancing pulses of 25 μs.

The bistable devices BS_3 and BS_4 are arranged as a counter-of-4 with BS_3, the input bistable device, driven by the rear edge of the advancing pulses.

Whatever the initial conditions of the bistable devices BS_3 and BS_4, when power is initially applied to the circuit, they are now both in condition 0, since otherwise a signal passes mixers m_{14} and m_{15} to authorize gate g_{26} to send "D" pulses to produce advancing pulses. In this manner, the input lead 1 of the latter gate g_{26} is activated during 735 μs. (FIG. 9) in total, so that exactly four advancing pulses are produced, which are applied to the shift registers. After the fourth pulse, both BS_3 and BS_4 are again in condition 0, and since MS_{11} is now back to normal, the generation of further pulses is stopped.

The information thus leaving the tube 44 of the last tetrad of ML_2 is applied to the monostable multivibrator MS_7 (FIG. 6) which is however only triggered when a 1 digit leaves said tube 44. The thus produced 50 μs. signal then may be fed to the tube 1 of the recording tetrad Rt through the AND gate g_{24} and the mixer m_{10}. Indeed, the other input lead of this gate g_{24} is constituted by the output lead of the AND gate g_{23} which delivers a

high signal, since both its input leads are activated, due to the reading authorization being removed and the relay $D_{14}r$ being released (−25 volts, i.e. an inhibiting signal at input of inverter i_6).

From the tetrad Rt the information is further transmitted through the monostable multivibrator MS_9, the gate g_{20} and the mixer m_{21} to the tube **1** of the shift register ML_1 in a manner already described above.

From FIG. 9 it is also easy to see that the output lead of the mixer m_{14} is activated during 600 μs. i.e. during the generation of the last three advancing pulses. The signal appearing at the left output lead of the bistable multivibrator BS_4 is applied, together with the signal appearing at the left output lead of the bistable multivibrator BS_3, to the gate g_{28} which thus delivers the so-called "Had" signal that is able to operate the monostable multivibrator MS_{10} at the end of the fourth advancing pulse, i.e. when both BS_3 and BS_4 again reach their 0 conditions together.

The resulting 35 ms. signal then operates the relay $C_{13}r$ so that the parallel connected and previously operated relays C_4r, $D_{18}r$ are released by the opening of the closed break contact $c_{13}r_2$.

The other digits may now be successively set up in the adding machine, the information stored in normal form being recirculated, all in the manner described above.

The sorting prefix and the account number are completely set up in the adding machine at the moment the normal form of the stop symbol is stored in the tubes **37** to **40** of the shift register ML_1. The sign of amount is then stored in the last tetrad of the shift register ML_2.

The signals appearing at the output leads of the tubes **37, 40, 38, 39** the latter two signals after having been inverted by inverters i_3, i_{19} respectively are applied, together with the "Had" signal and the inverse of the reading authorization signal, to the gate g_{31}. Thus the output lead t of the latter gate g_{31} becomes activated and the relay C_1r (FIG. 2) is operated.

Since the operation of the relay C_1r removes the ground from the contact d_1r (FIG. 1), when opening its break contact c_1r_1, no digits can be entered into the adding machine, so that the sign of amount stored in the last tetrad of the shift register ML_2 cannot be set up in the adding machine. By closing its make contact c_1r_2, the relay C_1r further operates the relay D_3r. By closing its contact d_3r_2, the ground from the home position contact HPC of the printer is brought on the relay $C_{11}r$, which further operates $C_{14}r$, so as to produce a series of four advancing pulses that shift the sign of amount out of the last tetrad of the shift register.

Due to the closure of the make contact d_3r_1, the non-add electromagnet NAM is operated through the closed made contact d_2r_2 of the relay D_2r, operated in a manner described above. The home position contact HPC of the printer is a change-over contact which takes a position, as shown on FIG. 2, only when the printer is at rest.

When the relay B_4r is not operated, i.e. in the case of automatic feed and for cheques after the first of a series having the same account number, then advancing pulses are admitted on the shift registers also due to the monostable multivibrator MS_8 (FIG. 7) being in its unstable condition. It is put in this condition by a "C" pulse which is allowed through the gate g_1 (FIG. 7) when the single pulse generator SPG_1 is operated (break contact b_4r_1 closed). This generation of advancing pulses is however not stopped by a significant digit of the account number being stored in the last tetrad of the shift register ML_2, since the output leads of the gates g_4 and g_5 are both deactivated.

It may be stopped when the output lead of the gate g_{31} is activated in the above described manner. Indeed a "C" pulse can then be fed through the gate g_3. This "C" pulse is delayed by delay element D_1 by 400 μs. before being applied to the monostable multivibrator MS_2 which activates the input lead **2** of gate g_5 during 30 ms. This delay should now permit at least one advancing pulse to be generated. In the absence of the "Had" signal, mixer m_3 delivers a signal and accordingly mixer m_1 does not, whereby the triggering of MS_2 is still without effect. But as soon as the "Had" signal reappears after the sign of amount has been shifted out of ML_2, this condition can only remain, provided a decimal digit 0 is stored in the last tetrad of ML_2. Otherwise, m_3 no longer delivers an output signal and the next "C" pulse may pass through gate g_5.

Thus, as soon as the first significant digit of the amount, is stored in the last tetrad of ML_2, gate g_5 delivers a pulse which passes through mixer m_{20} to trigger the monostable circuit MS_8 back to its stable condition. Operations will then proceed, as described in the case of single feed.

Returning now to the case where printing of the account number is desired, e.g. single feed, when the non-add electromagnet NAM is operated, the printer motor is started and the home position contact HPC is displaced, so that a ground is given to the parallel connected relays E_2r, C_5r which thus operate.

By opening its break contact e_2r_1, the relay E_2r removes the ground from Lk_1 (FIG. 2) thus releasing all the relays locked on Lk_1, while by closing its make contact e_2r_2 it energizes the relay C_6r (FIG. 2), so that the charged capacitor C_3 is discharged by the closure of the make contact c_6r_2 in a manner analogous to that described for the capacitor C_1 (circuit of relay $A_{16}r$). When the relay C_6r afterwards releases, the printer being again in its home position (HPC closed), the relay C_7r will be temporarily energized during the charge-time of the capacitor C_3. It thus releases the relay $C_{10}r$, in case of single feed (AF_1 open), and makes the total key effective.

By opening its break contact c_5r, the relay C_5r opens the circuit for the relay $C_{15}r$ so that the single pulse generator SPG_1 may no longer be operated. In this manner the corresponding input leads of the gates g_1 and g_2 may no longer be activated.

Summarizing, in case of automatic feed starting with the second item, the sorting prefix, the account number and the sign of amount are not set up in the adding machine and the printer need not be operated. In the case of single feed, the sorting prefix and the account number are set up in the adding machine and the printer is operated for printing this information.

When the printer motor reaches a so-called half cycle position, the length of this half cycle being determined by a camwheel fixed on the motorshaft, a so-called half cycle contact *hcc* is closed. The relay B_3r (FIG. 2) is thus operated, and by opening its break contact b_3r the locking circuit for the relays B_6r, B_8r is opened.

During the operation of the printer the information stored in the adding machine is printed. After this is finished, the storing of digits in the adding machine may then continue in a manner described above. The non-significant zeros of the amount are then also prevented from being printed, as described with regard to the sorting prefix and the account number.

In all cases, when all the significant digits of the amount are transmitted to the adding machine, the stop symbol arrives in the last tetrad of the shift register ML_2. The output lead of the gate g_{30} is then activated and this signal is applied through the mixer m_1 to the gates g_4 and g_5. When a processed cheque is provided with zero amount, due, for instance, to a wrong encoding operation, then the advancing pulses will be stopped as follows. In the case of automatic feed (second, third, . . . etc. cheques), the first arriving "C" pulse then resets the monostable multivibrator MS_8, through the gate g_5 while in the case of single feed, it is reset by a "C" pulse fed through the gate g_4.

The output signal of gate g_{30} also operates the relay C_3r. Due to opening of its break contact c_3r_1 no digits

can be set up in the adding machine, since the ground is removed from the circuit of the digit solenoids (FIG. 1). By closing its make contact c_3r_2 the parallel connected relays $A_{13}r$, D_4r are operated and also the relay A_2r but only in the case of automatic feed, the contact AF, then being closed.

The relay D_4r energizes the add electromagnet AM (FIG. 3) as follows:

Battery, coil of the add electromagnet AM, closed make contacts d_2r, d_4r_2, ground.

By closing its make contact d_4r_1, the relay D_4r operates the relay $C_{11}r$ through the ground of the home position contact of the printer. Thus a series of four advancing pulses are applied to the registers, shifting the stop symbol out of these.

When the add electromagnet AM is operated, the printer motor is started, the information (i.e. the amount) stored in the adding machine is printed, while it is stored in the totalizer.

When the printer motor is started, the ground of the home position contact HPC is applied to the parallel connected relays E_2r and C_5r with the effect already described above.

By closing its make contact $a_{13}r$, the relay $A_{13}r$ operates the feed electromagnet FM (FIG. 3) which commands the removal of the document carrier positioned in the reading stage. The relay A_2r, only operated in case of automatic feed, acts nearly in the same manner as did the relay A_1r when processing the first cheque, so that another document may be brought in the reading position. No circuit is then closed for the operation of the relay B_4r which thus remains released.

When the add electromagnet AM operates, it closes its top contact Epc so as to operate the relay B_5r which causes the relays B_9r, $B_{11}r$, $B_{16}r$, $A_{15}r$ and eventually B_2r, B_4r to release.

At the moment the printer arrives in its so called half cycle position, the relay B_3r (FIG. 2) is operated through the closed half cycle contact *hcc*, thus unlocking the parallel connected relays B_6r and B_8r when opening its break contact B_3r.

When a cheque with a different account number is detected, and also when a discrepancy was detected during the comparison of the two forms of the same information, the total key has to be depressed. Indeed, the shift registers have then to be cleared. It is to be remarked that only in these cases is the total key effective, since the relay $C_{10}r$ is then released, as was described above.

When depressing the total key TK, the parallel connected relays E_3r, $D_{14}r$ and F_1r are operated. By closing its make contact $d_{14}r_2$, the relay $D_{14}r$ activates the input lead of the gate g_{26} through the mixers m_{13}, m_{15}, so that advancing pulses are applied to the shift registers. Since the relay $D_{14}r$ is operated more than 20 ms., it is assured that enough advancing pulses will be applied to the shift registers to clear them completely. By opening its break contact $d_{14}r_1$, the relay $D_{14}r$ resets the bistables multivibrators BS_1 and BS_2, and by closing its make contacts e_3r_2, the relay E_3r operates the total electromagnet TM.

The reset for each of the bistable multivibrators BS_1 and BS_2 takes place by the removal of the −250 volts, leading to an increase of the resistance (due to the removal of a short-circuit) in their anode-grid potentiometer circuit and a consequent triggering of each of the devices in a pre-determined condition. The electromagnet TM causes the adding machine to produce the total of the amounts and initiates another cycle of the printer mechanism which prints the thus obtained total. By opening the break contact e_3r_1 the ground is removed from Lk_2, thus resetting all the relays locked on Lk_2.

It was mentioned above how at a certain moment the feed electromagnet FM was operated. In the case of automatic feed, when a new account number is detected, the removal of the document carrier, enclosing this new cheque and situated in the reading stage, is however prevented by means not shown. In this manner, the read document is transmitted to the adjacent stage, or so-called "unjacketing stage," where the cheque may be removed out of its document carrier. Afterwards the document carrier is transferred to a so-called output position, wherein a mechanism is mounted so as to transfer the document processed from the edgewise conveyor, along which it was processed, onto a transverse conveyor. Such a mechanism is described in the Belgian Patent No. 577,765.

While the principles of the invention have been described above in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

I claim:

1. A system for decoding digital information recorded on documents comprising:

(*a*) means for continuously receiving binary digit signals representing information recorded on a document and corresponding time reference signals recorded with said binary information signals, the same information being serially recorded and received in first and second different code forms in each of which the information is arranged in successive binary combinations representing successive decimal digits,

(*b*) a source of locally produced data timing signals,

(*c*) gating means coupled to said source, for intermittently passing the signals issuing therefrom in decimal digit timing groups,

(*d*) means coupled to said receiving and gating means for producing advancing pulses,

(*e*) a shift register coupled to said receiving means and said advancing pulse producing means, said shift register having the capacity to store one complete form of the said information, and thereby being operative to serially receive said information in said first and second forms and to thereafter statically store said information in said second form until said gating means is enabled,

(*f*) first control means for controlling said receiving and gating means in alternate time intervals,

(*g*) means coupled to said first control means for recirculating the output of said shift register back through the input of said register during activation of said gating means thereby recirculating said second form of said information, in intermittent decimal digit groups, following operation of said receiving means,

(*h*) comparing means coupled to said shift register and said receiving means for comparing the binary information entering and leaving said register during operation of said receiving means,

(*i*) verification means coupled to said register, said receiving means, said first control means and said comparing means for producing a verification indication during the redundant transfer of said second form of said information from said receiving means into said register, thereby producing an indication of malfunction whenever said shift register is improperly operated or whenever said second form of said information does not precisely correspond to the previously transferred first form thereof.

(*j*) and utilization means coupled to said gating and first control means and to the group of successive output stages of said register which contains the first entered decimal digit for intermittently utilizing the decimal digit information stored in sad second form as it is intermittently recirculated through the input of said register.

2. A system according to claim 1 including:

(*a*) second control means coupled to said register, and said utilization means for disabling said utilization means during the application of non-significant zero decimal combinations thereto.

3. A system according to claim 1 including:

(a) third control means coupled to said comparing means, said receiving means, and said register, said third control means being selectively operative during the transfer of a portion of said first form of said information from said receiving means into said register, to suspend further system operation if the said portion of said information is different from the corresponding portion of the second form of information previously intermittently recirculated through said register, and therefore contained on a previously read document.

4. A system according to claim 1 wherein said utilization means comprises:

(a) decoding means for converting the binary decimal digit combinations stored in the said group of output stages of said shift register into a signal on one of 10 output lines,

(b) adding means including ten stationary solenoids and a serially operative selecting mechanism including a variably positionable matrix of stop elements, said solenoids being operative to displace corresponding ones of said elements in the adjacent column of said matrix as the said matrix is moved relative to said solenoids,

(c) and means for selectively coupling signals on the said output lines of said decoding means to corresponding ones of the said solenoids.

5. A system according to claim 4 including:

(a) verification decoding means operative to convert the decimal digit combinations stored in said output stages of said register into a signal on one of 10 additional output lines,

(b) and means coupled to said additional output lines of said verification decoding means and to said decoding means for preventing operation of said means for selectively coupling signals to said solenoids and for suspending operation of said system.

6. A system for processing digital information encoded on a document in first and second different code forms, said information including an account number group identifying code and a stop code, said system comprising:

(a) a buffer shift register having the capacity to store exactly one form of said information between given input and output stages thereof,

(b) means coupled to said register for serially transferring said information from said document into said register twice, first in said first code form and then in said second form,

(c) means coupled to the said given input and output stages of said register for comparing the signals stored therein,

(d) means for indicating improper operation of said system,

(e) first means coupled to said indicating means, said comparing means, and to a given first group of stages in said register, for coupling the output of said comparing means to said indicating means for a predetermined interval of time following the appearance of the said stop code in said first code form in said first group of stages, during which predetermined interval the said information in said second form is completely entered into said register and the said information in said first form is completely transferred out of said register,

(f) utilization means adapted to receive information in serial form,

(g) means coupling the output of said register to said utilization means following the appearance of said stop code in said first group of stages in said second code form, including means for stepping said register at a rate commensurate with the rate of operation of said utilization means, and

(h) means coupled to said coupling means for recirculating said information back thru the input of said register during the said stepping thereof.

7. A system for processing digital information encoded on a document comprising:

(a) means for serially scanning binary information signals encoded on a document twice, once in normal form, and once in inverted form, said information arranged in four bit binary decimal code groups and including an account number identifying portion and a stop code portion,

(b) means coupled to said scanning means for producing timing signals synchronized with the time positions of said scanned binary signals,

(c) means coupled to said scanning means and to said timing signal producing means for receiving said binary signals,

(d) a shift register coupled to said timing signal producing means and to said receiving means for serially storing the said information, first in inverted form and then, in said normal form,

(e) stop code detection means coupled to said shift register means for detecting the progress of said information through said shift register,

(f) frequency dividing means for disabling said stop symbol detection means during insertion of information therein, until said register has been advanced thru a complete tetrad of binary digit steps corresponding to the advance of a single decimal symbol therein,

(g) comparison means coupled to input and output stages of said shift register for detecting correspondence between information signals entering and leaving said shift register,

(h) and means coupled to said stop symbol detection apparatus and to said comparison means for utilizing the output of said comparison means at predetermined phases of the progression of said information through said shift register whereby said comparison output utilizing means is useful to indicate a malfunction in either the shifting apparatus or an error in the encoded information being read from said document, during entry of said normal form of said information, as well as the differences between selected portions of the previous contents of the register and corresponding portions of said inverted form of said information.

8. A system according to claim 7 and further comprising:

(a) print symbol selection means associatable with an adding machine,

(b) decoding means coupled between said print symbol selection means and the output of said shift register means for selecting one of a plurality of print symbols while said scanning means is idle,

(c) means coupled to said decoding means for verifying each print symbol selection,

(d) and means associated with said decoding means for intermittently actuating said timing signal producing means to advance said shift register in series of four digit steps for each decoding operation thereof.

9. A system according to claim 8 further including means for automatically recirculating the information stored in said shift register in normal form during the said intermittent actuation of said register zero.

10. In a data processing system the combination comprising:

(a) a shift register having an input and an output stage,

(b) means coupled to said shift register for selectively recirculating information signals emerging from said output stage back through said input stage

(c) a source of serial data signals including a reference stop signal combination arranged in a redundant train consisting of a first code form of said data followed

by a second code form different from said first code form,

(*d*) means coupled to said source of signals for circulating said signals through said shift register,

(*e*) means coupled to said shift register for comparing the states of said input and output stages thereof,

(*f*) means coupled to said shift register for detecting said stop symbol in said first code form upon entry thereof into said shift register,

(*g*) and means coupled to said stop symbol detection means for sampling the output of said comparison means while said second code form of said data is being passed through said shift register.

11. A system according to claim 10 further comprising:

(*a*) additional stop symbol detection apparatus for detecting the said stop symbol at an intermediate point in its passage through said shift register,

(*b*) and second sampling means coupled to said comparison means and said additional stop symbol detection means for sampling the output of said comparison means in selected intervals of time during which corresponding sub groups of successive different trains of data are passing through said shift register, the first of said successive groups being arranged in said second code form and the following one of said successive data groups being arranged in said first code form,

(*c*) whereby said sub group comparisons may be used to selectively suppress the passage of said data signals to output apparatus associated with said shift register.

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