Oct. 24, 1961 O. VIERLING 3,005,872

MEANS FOR DECODING SIGNALS TELEGRAPHED IN BINARY CODE AND FOR CONTROLLING TELEPRINTERS

Filed Sept. 28, 1959 3 Sheets-Sheet 1

Fig. 1

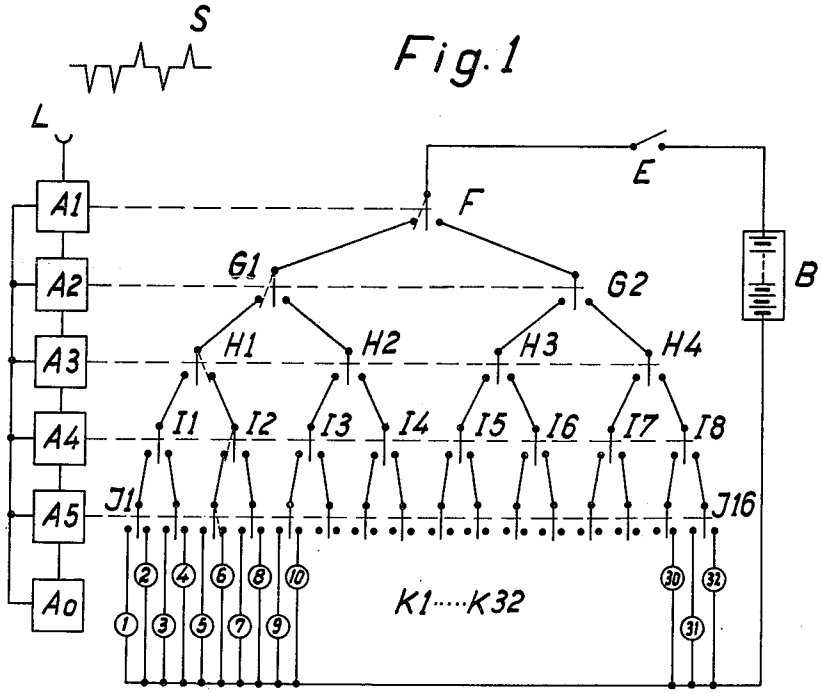
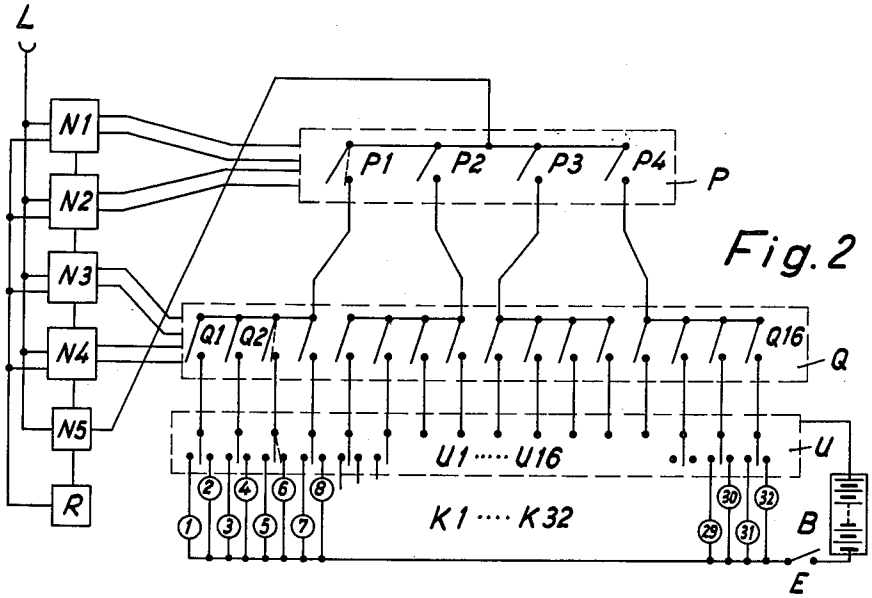


Fig. 2



Inventor:
O. Vierling
By Glascock Downing & Seebold
Attys.

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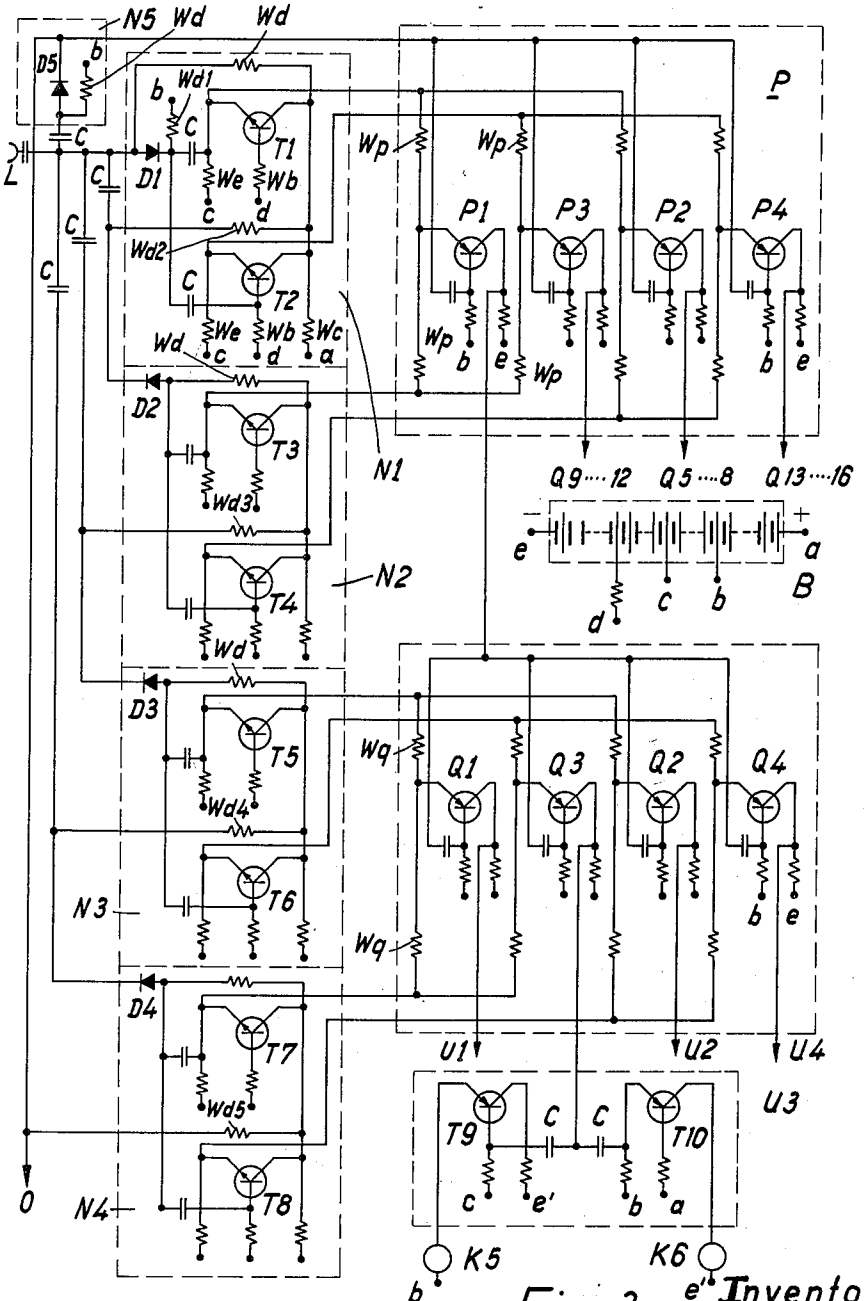
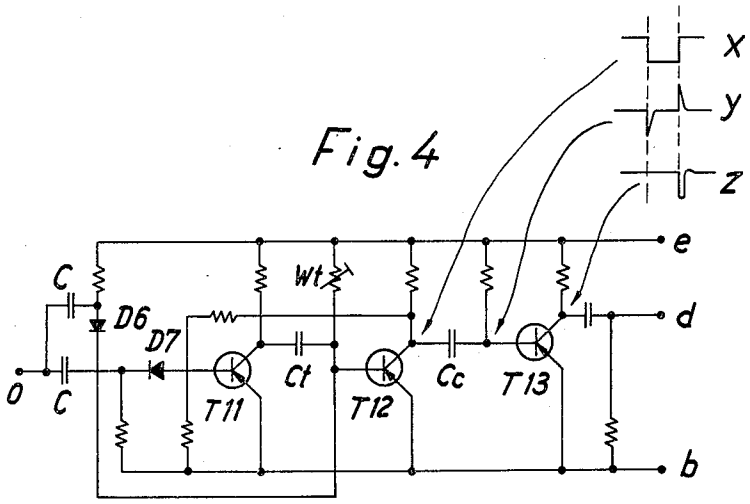


Fig. 3

Inventor:
O. Vierling
By Glascock Downing Seebold
Attys

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MEANS FOR DECODING SIGNALS TELEGRAPHED IN BINARY CODE AND FOR CONTROLLING TELEPRINTERS
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Fig. 4



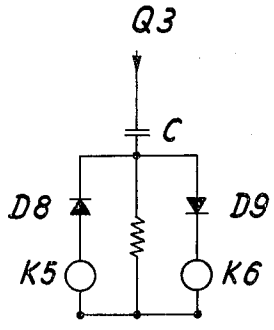


Fig. 5

Inventor:
O. Vierling
By Glascock Downing & Seebold
Attys.

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3,005,872

MEANS FOR DECODING SIGNALS TELEGRAPHED IN BINARY CODE AND FOR CONTROLLING TELEPRINTERS

Oskar Vierling, Pretzfelder Strasse 174, Ebermannstadt, Germany

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Claims priority, application Germany Sept. 30, 1958
6 Claims. (Cl. 178—33)

This invention relates to an arrangement for the translation (de-coding) of binary-coded telegraph signals in the form of *n*-digit impulse-element combinations, which are composed of *n* individual impulses of positive or negative potential following one another in point of time, particularly an arrangement for the control of teleprinter receiving devices.

Ordinary teleprinting code signs, such as are transmitted as telegraph signals, are composed of a number of current elements of two different potentials. Here the number of current element depends upon the code employed and upon the process of transmission. There is, for example, an internationally standardised five-unit binary code with two supplementary element, which serve for starting and for stopping the receiver. The duty of the receiver is therefore to convert, from time to time, a code combination of elements consisting of seven impulses into a form suitable for interpretation, and to feed it to an interpretation arrangement, in which the actual *n*-digit (for instance 5-digit) code combination is identified (translated) and an actuating impulse is given to one of 2^n (for instance 32) interpreting members, which immediately, it may be, prints in clear type a sign allocated to the code-element combination.

Now this invention relates to an improved interpreting arrangement which carries out the identifying (deciphering) of the coded signs, and can serve for controlling the interpreting members.

Arrangements which fulfil the said purpose are known in themselves. These known arrangements consist in general of electro-mechanical assemblies, in which a plurality of mechanically moved parts and almost exclusively mechanically moved contacts are employed. Thus the known arrangements necessarily exhibit the disadvantages of noisy working and heavy wear. They also require a considerable expenditure for supervision and adjusting work. Finally also the speed of working of the known arrangements for interpreting the code combinatios in comparatively low. It is therefore of interest to increase the speed of interpretation.

This invention provides a remedy by means of an interpreting arrangement consisting of purely electrical constructional elements, the object of which is to obviate the abovementioned disadvantages.

In dividual constructional elements and assemblies of the electrical interpreting arrangement according to the invention are in themselves already known. Thus it is in case of need usual, in electronic technology, to employ so-called counting chains of relays, in which each link of the chain contains a bi-stable or two-state connection. These connections are also constructed with semi-conductive elements. As bi-stable semi-conductive elements there are employed for example combinations of two junction transistors, or a point-contact transistor, or a double-base diode, or finally a so-called switching transistor. All such bi-stable elements exhibit a negative resistance characteristic, and are substantially equivalent to one another. The links of the counting chain of relays are so controlled, by way of special switching elements it may be, that the impulses of a train of impulses arriving at the input of the counting chain of relays

are each supplied individually from time to time to a link of the counting chain.

The interpreting arrangement according to the invention for the interpretation (translation) of binary-coded telegraphy signals in the form of *n*-digit impulse-element combinations which are composed of *n* individual impulses of positive or negative potential succeeding one another in point of time, particularly an arrangement for the control of teleprinting receiving devices, is characterised essentially by a counting chain of relays connected to a supply line for the impulse-element combinations to be interpreted, the chain of relays comprising counting-chain links which each contain two bi-stable semi-conductive elements, one of which can be switched by a positive impulse and the other by a negative impulse; impulse gates which are controllable by the counting-chain links and which supply the impulses of the *n*-digit impulse-element combinations arriving in the arrangement individually in succession each to one of the counting-chain links; a selective branching connection branching stepwise up to a maximum of 2^n outputs, in the branching stages of which are arranged electronic selective switching elements controllable stepwise by the impulse-element combinations substantially by way of the bi-stable semi-conductive elements of the counting-chain links, these switching elements selecting one of the outputs by means of their impulse-dependent control; interpreting members individually connected to the outputs of the selective branching connection, of which the particular one that is located on the selected output is actuated by an actuating impulse released by the last impulse of the impulse-element combination; and a resetting appliance restoring the arrangement to the initial position after the interpretation of an impulse-element combination.

Owing to the fact that in the links of the counting chain there are two bi-stable semi-conductive elements, the part of the arrangement following the counting chain and connected to the links of the counting chain and constructed in the manner of a selective branching connection with electronic switching elements is very easy to supervise; it preferably consists almost entirely of purely similar transistor stages acting in the manner of circuit-closing or double-throw switches. These transistor stages also admit at the same time of being utilised as amplifiers for an actuating impulse to be passed on by the selective branching connection.

A further advantage of the arrangement according to the invention is given by the fact that the succeeding transistors of the branching connection are connected directly, that is, without the interposition of galvanically coupled intermediate stages, with their tendency to cause drift phenomena, to the counting-chain links, and the counting-chain links are not overloaded as regards power.

In a further development of the invention the transistors located in one branching stage of the branching connection are each biased by a bi-stable semi-conductive element of two successive counting-chain links in such a way that they exhibit a working point suitable for amplification only when the bi-stable semi-conductive elements of both the counting-chain links are in the reversed condition.

With the entry of the impulses of a code signal impulse train, therefore, definite transistors, given or selected by the sequence of impulses, in the branching connection, are brought out of the blocked condition into a working condition.

In the case of a preferred form of construction of the invention, the transistors, adjusted by the bi-stable semi-conductive arrangements to the desired working point, are supplied with the last impulse of an in-coming code signal, which then follows, with simultaneous amplifica-

tion by the transistors, the path prepared in the branching connection by the sequence of impulses received, by way of the last branching stage (in which it may itself determine its further path by its own polarity) and actuates the selected interpreting member. The transistors are so coupled or connected in groups that for the reception of code element combinations with an even number of elements, one transistor is allocated to each in-coming element combination, whereas in the case of code-element combinations with an odd number of elements, one transistor is allocated in each case to two combinations of elements differing only with respect to the polarity of the last element, on the collector of which transistor, upon the arrival of the combination in question, the last impulse thereof appears in amplified form. The further selection that is necessary in code-step combinations having an odd number of elements is effected in the last stage of the branching connection, preferably with the help of two oppositely "polarised" transistors or semi-conductive diodes each.

From the transistors or the semi-conductive diodes to the outputs of the branching connection, the impulses, preferably already amplified in the branching connection, pass to members for the clear-script reproduction, for instance to the type magnets of a printing appliance, an electrical typewriter for example, which writes in clear script the messages received.

The positive and negative impulses of the individual code combinations, to be utilized or dealt with by the arrangement according to the invention, are converted from the incoming telewriting signs, in a known and conventional manner, for instance by amplifying, limiting and differentiating, into trains of impulse elements with sharp positive and negative individual impulses. In so doing, any starting and blocking steps that may be present at the same time are separated out, so that to the interpreting arrangement according to the invention only the actual code-element combination of *n* impulses is supplied.

The invention will now be further explained with reference to the accompanying drawings, in which:

FIGURE 1 shows a diagrammatic and greatly simplified circuit diagram of an interpreting arrangement according to the invention for telegraphic signals of a binary code with five-digit element combinations, which can be used for instance for the control of an electrical typewriter;

FIGURE 2 shows a greatly simplified circuit diagram of an interpreting arrangement which works according to a principle similar to that of the arrangement in FIGURE 1, but needs fewer switching means in the branching connection;

FIGURE 3 shows a detailed circuit diagram of the most important part of the interpreting arrangement of FIGURE 2;

FIGURE 4 shows a detail of the connections of the arrangement according to FIGURE 2; and

FIGURE 5 shows a detail of the connections to be optionally or selectively employed in the arrangement according to FIGURE 3.

FIGURE 1 shows, at the left-hand margin of the figure, the counting chain of relays consisting of five links A_1 to A_5, to the input L of which the trains of impulse elements are applied, which, before entering the input L, have been amplified, limited and differentiated, by known devices, not shown. As an example of such a train of impulse elements, beside the input L of the counting chain the impulse train S is marked, which is composed of two negative impulses, followed by a single positive, then again a negative, and finally a positive single impulse.

The closure of the counting chain is formed by the link A_0, the object of which is to return the counting chain into the original condition after the passage of the impulse train S.

On the right, beside the counting chain, is shown a selective branching connection, which, in the case of this example, serving only for the purpose of explaining the fundamental method of working, for the purpose of simplifying the representation, may be fed from a battery B by way of a switch E. The selective branching connection contains in each branching stage switching means of an electronic nature, which in the position of rest are open, and which from time to time, in stages, by the links A_1 to A_5 of the counting chain switched by impulses, can be brought into a condition in which they prepare one of two possible current paths within the stage in question of the branching connection.

Thus the first electronic switch F is dependent upon the first counting-chain link A_1, while the two switches G_1 and G_2 of the second stage are dependent upon the counting-chain link A_2. The switches H_1, H_2, H_3 and H_4 are controlled by the counting-chain link A_3; the counting-chain link A_4 controls the switches I_1 to I_8; and the last counting-chain stage A_5 controls the switches J_1 to J_{16}. To the two output contacts of each of the switches J_1 to J_{16} of the last stage of the branching connection, interpreting members K_1 to K_{32}, constructed for instance as type magnets, can be switched on, and these in their turn are all connected to the other pole of the battery B.

According to the invention the links A_1 to A_5 of the counting chain (the construction of which will be gathered from FIGURE 3) contain in each case two bi-stable semiconductive elements, one of which in each case is switched over by a positive impulse and the other by a negative impulse. By this change-over of one of the two semiconductive elements of the counting-chain link in question, this counting-chain link is at the same time, in a manner to be hereinafter explained, blocked against further impulses, and a succeeding impulse is fed to the next counting-chain link, in which, according to the direction of the succeeding impulse, a change-over of one of the two bi-stable semi-conductive elements of this link is then likewise effected.

The semi-conductive elements of each counting-chain link A_1 to A_5 now act in such a way upon the switches of the stages F, G, H, I and J of the branching connection that each switch of one stage is brought, by a negative impulse on the counting-chain link allocated to the stage in question, into a condition in which it establishes a connection with the left-hand branching conductor, whereas with a positive impulse it establishes a connection with the right-hand branching conductor.

When the train of impulses denoted by S is received, the first negative impulse occasions, in the counting-chain link A_1, the response or change-over of the bi-stable semiconductive element of this link reversible by negative impulses. This in its turn controls the switch F to the left into the condition shown by a dotted line. The second negative impulse is operative in the counting-chain link A_2, and this likewise throws over the two switches G_1 and G_2 to the left. The third impulse, positive, then following, brings about, in the counting chain link A_3, a response from the semi-conductive element, which is reversible by a positive impulse, and which in its turn throws over all the switches H_1 to H_4 to the right. The succeeding impulse, negative, evokes in the counting-chain link A_4 the response of the bi-stable semi-conductive element reversible by negative impulses, which in its turn throws over to the left all the switches I_1 to I_8. In the last counting-chain link A_5, the last impulse, which is positive, releases a reversal of the switches J_1 to J_{16} to the right.

In the branching connection, dotted lines are employed in each case to represent the conditions of only those switches F to J which become operative in the selection of the interpreting member allocated to the impulse sequence S. These are the switches F, G_1, H_1, I_2 and J_3. It is recognised, provided the switch E is closed, that by the impulse train S a connection is established between the branching-connection input connected to one pole of the battery B and the interpreting mem-

ber K_6, which is connected to the other pole of the battery, and is consequently actuated by closure of its actuating circuit when the switch J_3 is thrown over. The interpreting member K_6, if it is a typing magnet of an electrical typewriter, prints a definite sign, for instance a letter corresponding to the impulse sequence or to the code-element combination S, in a known manner. All the other interpreting members K_1 to K_5 and K_7 to K_{32} remain at rest, since, as can easily be seen, their circuits are not closed.

By the last counting-chain link A_5, on the other hand, the counting-chain link A_0 is also controlled, which, immediately after the response of the interpreting member K_6, restores all the counting-chain links. By this restoration of the counting-chain links, the switches of the stages F, G, H, I and J are also all brought back to their initial positions, in which all the branching places are interrupted.

Reference may be made to the fact that the switches of the stages F, G, H, I and J in the branching connection, shown as reversing switches for the purpose of simplifying the representation, are in fact not mechanically switching contact appliances but electronic arrangements known in themselves, particularly transistor arrangements, which are controlled by the bi-stable elements of the counting-chain links in such a way that they carry out the functions of a reversing or change-over appliance. Since, as it known, transistors or transistor arrangements can be controlled with a small expenditure of controlling energy, there is no risk of overstressing the counting-chain links, particularly the last counting-chain link A_5, which has to control sixteen such arrangements at the same time.

Further details concerning the manner of connecting or influencing the transistor arrangements of the branching connection are given later on, in connection with the descriptio of FIGURE 3.

From FIGURE 1, which has just been described, it will be seen that the number of transistor "change-over appliances" in the branching connection is comparatively high, since in each successive stage of this branching connection the number of change-over appliances is doubled. If it is desired to employ transistors of as normal a kind as possible in the branching connection, two such transistors must moreover be inserted for each change-over appliance. This means that for the branching connection according to FIGURE 1, altogether

$$2+4+8+16+32=62$$

transistors are required, if five-digit code signals are to be de-coded or translated.

By the aid of an arrangement such as that shown in FIGURE 2, the number of switches needed, particularly the number of transistors in the branching connection, can be reduced, and furthermore the method of working of the interpreting arrangement as a whole can be simplified and improved.

With this arrangement, two sucessive links of the counting chain act in each case jointly upon one group of switching means in the form of transistors acting as circuit-closing switches, which, within the branching connection, in each of the two stages P and Q, select in each case one of four possible paths.

In this constructional example of the invention, the counting chain consists of five counting-chain links N_1, N_2, N_3, N_4 and N_5, of which the links N_1 and N_2 act jointly upon transistors of the group P (P_1, P_2, P_3 and P_4), while the two following counting-chain links N_3 and N_4 act upon the transistors of the group Q (Q_1, Q_2 . . . Q_{16}). The last stage of the branching connection, which in this example consists of the sixteen switches U_1 to U_{16} represented as change-over switches, is now however not controlled directly by the last counting-chain link N_5. In this last stage, only changeover means that respond to the polarity of an impulse traversing the branching connection are provided.

This impulse is guided by the last counting-chain link N_5, preferably acting only as a gate, into the input of the branching connection (input of the group P) amplified within the branching connection in transistors of the groups P and Q which determine in each case the selected path, and then passed on, in one of the change-over means of the group U, to the member selected from the interpreting members K_1 to K_{32}.

By the last impulse the switch E is also closed, so that an actuation of the selected interpreting member is effected.

Exactly as in the example according to FIGURE 1, a restoration of all the links of the counting chain is also required in the arrangement according to FIGURE 2, after an impulse train S has passed through. This purpose is served by the restoring appliance R. In this restoration, the transistors of the groups P and Q, which had been brought by an impulse train S into the conditions symbolized by the dotted switch positions, also go back into their "open" initial conditions.

With reference to FIGURE 3, which represents in detail the circuits of the arrangement of FIGURE 2, the fundamental structure of the counting-chain links, and the co-operation of each two counting-chain links with groups of four electronic switching means, only one of which is selected and "actuated" according to the incoming impulses, will be more fully explained.

FIGURE 3 shows towards the upper left-hand corner the input L, consisting of an input condenser, of the counting chain embracing the four links N_1, N_2, N_3 and N_4, and also the last gate-link N_5. The first four links N_1 to N_4 of this counting chain each comprises two bi-stable semiconductive elements in the form of transistors T_1, T_2; T_3, T_4; T_5, T_6; and T_7, T_8, while the last counting-chain link N_5 contains only one gate-diode.

The transistors T_1 to T_8 of the counting-chain links N_1 to N_4 are coupled, for the purpose of correct stepwise advance of the counting-chain links by the impulses arriving, with gate-diodes D_1, D_2, D_3 and D_4. The transistors are adjusted, by suitable dimensioning of their resistances (Wc=joint collector resistance, Wb=base or ground resistance, and We=emitter resistance) to a bi-stable working characteristic. In the state of rest of the arrangement, all the counting-chain transistors are in the blocked condition.

Between the input L of the counting-chain connection and the gate-diodes D_2, D_3, D_4 and D_5 are located blocking condensers C, which are necessary in order to enable the diodes to be opened or closed independently of one another by appropriate bias voltages. Beyond each of the diodes D_1 to D_4 are located further blocking condensers C in the control conductors for the reversal of the bi-stable transistors.

On the outer voltage connections of the circuit are marked the letters *a* to *e*, which are to indicate the relative level or value of any voltages to be applied to these points. By way of elucidation, to the right in the middle of FIGURE 3 a source of voltage B (as a battery) is represented. This supplementary FIGURE shows that the point *a* has the highest positive potential and the point *e* the highest negative potential; and the points *b*, *c* and *d* denote intermediate voltages diminishing in that order.

The transistors T_1 to T_8 are all, as their emitting arrows indicate, NPN transistors. Their collectors therefore have the highest positive voltage *a*, while their bases have a voltage *d* lower than that of their emitters, which are connected to the point *c*. In the counting chain the feed voltages of the links diminish stepwise from link to link.

The gate-diode D_1 allocated to the first counting-chain link N_1 is connected on the one hand by way of an adjusting resistance Wd with the two collectors of the transistors T_1 and T_2, and on the other hand, by way of a second resistance Wd_1, with the voltage point *b*. Since the col-

lector potential (a) in the state of rest of the counting chain is higher than the potential b, the diode D_1 has a voltage bias in the conducting direction. It can therefore transmit an in-coming impulse.

Each of the diodes D_2, D_3 and D_4 is connected on the one hand, by way of a resistance Wd_2 or Wd_3 or Wd_4 respectively, with the collectors of the transistors of the particular preceding counting-chain link, and on the other hand, by way of the resistances Wd, with the collectors of the transistors of the associated counting chain link, the idle voltage of which is in each case somewhat lower than that of the preceding link. The last diode D_5 is connected by way of the resistance Wd_5 to the collectors of the transistors of the counting-chain link N_4, and on the other hand, by way of the resistance Wd, with the voltage point b. The diodes D_2 to D_5 are therefore, in the state of rest of the arrangement, biased in the blocking direction, and therefore blocked against in-coming impulses.

In the right-hand side of FIGURE 3, above, is represented an input stage P, consisting of four transistors P_1 to P_4, of the branching connection. In the middle there is the part of the second stage Q of the branching connection which is connected to the transistor P_1 and is built up from the transistors Q_1 to Q_4, and which also embraces three further parts, correspondingly connected to the transistors P_2, P_3 and P_4, with the transistors $Q_5 \ldots Q_8$, $Q_9 \ldots Q_{12}$ and $Q_{13} \ldots Q_{16}$; and right at the bottom is represented a switching means, consisting for example of two mono-stable transistors T_9 and T_{10}, of the last branching-connection stage U; the two transistors T_9 and T_{10}, one (T_9) of which responds only to a negative controlling impulse, and the other (T_{10}) only to a positive controlling impulse, forming together the switching means U_3. Finally to the two transistors T_9 and T_{10} are connected two interpreting members K_5 and K_6. All the transistors of the branching connection are in the blocked condition.

The emitters of the transistors P_1 to P_4 are connected in cyclic order, by way of two potentiometer resistances Wp each, to the emitters of the bi-stable transistors T_1 to T_4, so that in the state of rest the emitter potentials of the transistors P_1 to P_4 lie far below the potential of the bases of these transistors. The same applies to the transistors of the Q-stage of the branching connection, the emitters of which are correspondingly connected by way of the potentiometer resistances Wq to the emitters of the transistors T_5 to T_8.

For the explanation of the method of working of the connection let it be assumed that at the input L of the counting chain there arrives a sequence S of impulses, as indicated at the upper left-hand corner of FIGURE 1. This train of impulses has the combination

$$- - + - +$$

The negative impulse arriving first passes through the diode D_1 biased in the conducting direction, and loads, by way of the two blocking condensers C of the counting-chain stage N_1, both the emitter of the transistor T_1 and the base of the transistor T_2. The negative impulse reduces the voltage of the emitter of the transistor T_1 so far that this voltage falls to about the potential d of the base, and therefore the transistor T_1 abruptly reverses from its stable condition of rest into a likewise stable unblocking condition. The negative impulse simultaneously coming on to the base of the transistor T_2 has no action on this transistor, since it merely reduces the base potential further.

Owing to the fact that the transistor T_1 is conducting, the potential at the two collectors of the transistors T_1 and T_2 falls in consequence of the load current, and the potential at the emitter of the transistor T_1 increases. The fall in the collector potential is here so marked that the voltage applied by way of the resistance Wd to the positive pole of the diode D_1 drops below the value of the voltage point b, and therefore this diode is biased in the blocking direction, so that it is blocked against further in-coming impulses. Since the transistors T_1 and T_2 have a common collector resistance, when one of them is switched on the characteristic of the other also shifts so far that an additional changeover owing to the voltage impulses occurring upon the blocking of the diode D_1 cannot occur.

At the same time, however, the fall in the collector potential in the counting-chain stage N_1 causes an unblocking of the diode D_2, which had been biased in the blocking direction by the difference between the collector potentials of the two counting-chain stages N_1 and N_2. This opening of the diode D_2 admits of being delayed by known measures, for instance by the selection of high-ohmic resistances Wd, until the first impulse has completely faded away. In addition the change of voltage is effected so slowly that the operation of opening has no reactions upon the transistors of the counting-chain link N_2.

The second negative impulse now arriving passes by way of the unblocked diode D_2 to the emitter and to the bases of the two transistors T_3 and T_4 of the counting-chain link N_2. It changes over, of these two transistors, the transistor T_3 which is sensitive to negative impulses, as the result of which, on the one hand the potential at the emitter of this transistor rises, and on the other hand the potential at the collectors diminishes. This diminished collector potential now effects in its turn a renewed blocking of the diode D_2, and, by way of the series resistance or compensating resistance of the succeeding diode D_3, effects a delayed opening of this diode, which thus sets free, for the next in-coming impulse, the path to the counting-chain stage N_3.

Before however going further into the method of working of the counting chain it is first of all to be explained how the two counting-chain links N_1 and N_2 now act upon the input stage P of the branching connection. By the first negative impulse the emitter voltage of the transistor T_1 had been increased, and by the second negative impulse the emitter voltage of the transistor T_3 had been increased. By the simultaneous rise of these two emitter voltages, the emitter potential of the first transistor P_1 of the input stage P of the selective branching connection is raised so far above the potentiometer resistances Wp, which are brought, at their two outer terminals, to a relatively high potential, that this transistor comes to its normal working point, corresponding to a usual amplification. The other transistors P_2, P_3 and P_4 of the first stage P remain however in the blocking condition, since the change in their emitter voltages effected by any "one-sided" increase of the potential at one of the outer connections of their emitter potentiometer resistances Wp does not suffice to control these transistors into their normal working range; for on the transistor P_3 there acts only the positive emitter voltage of the transistor T_3, while on the transistor P_2 there comes into action only on one side the positive emitter voltage of the transistor T_1. The emitter potential on the last transistor P_4 of the stage P does not change at all. By the co-operation of two negative impulses and the bi-stable elements T_1, T_2, T_3, T_4 of the first two counting-chain links N_1 and N_2, therefore, a selection has been made from amongst the switching means of the first stage P of the branching connection, which has set merely one of four switching means in a working condition.

In a corresponding manner the two succeeding impulses now act in the counting-chain links N_3 and N_4, and also in all the sections or groups, each embracing four switching means, of the second stage Q of the branching connection.

The third impulse, which has been assumed to be positive, and which comes by way of the diode D_3 to the emitter of the transistor T_5 and at the same time to the base of the transistor T_6, this time changes over the transistor T_6, responding to positive impulses, and thus increases "one-sidedly" the emitter voltages of the two transistors Q_3 and Q_4, and also of the other correspond-

ing transistors of the branching stage Q, up to a value which however is still not high enough to put one of these transistors into the working condition. The negative impulse now following, which impinges upon the counting-chain link N_4, switches the transistor T_7 into a conducting condition, and thus causes an "other-sided" increase of the emitter voltages of the transistors Q_1 and Q_3 in the first section, as well as of the corresponding transistors in the other sections of the switching-means stage Q. Since the transistor Q_1 is connected only on one side with an emitter at higher voltage of the counting-chain links, it does not come into its working range. In the case of the transistor Q_3, and also of the transistors Q_7, Q_{11} and Q_{15} of the other sections, however, the raising of the emitter potential is effected from both sides, namely from the transistor T_6 of the counting-chain link N_3 and from the transistor T_7 of the counting-chain link N_4. The transistors Q_3, Q_7, Q_{11} and Q_{15} are therefore controlled into their working range. Of these, however, only the transistor Q_3 continues the current path already predetermined by the transistor P_1 in the branching connection right to the member U_3 of the third branching stage U.

The last impulse of the impulse train, which is again a positive impulse, passes over the diode D_5, which has meanwhile been opened, to the input of the first branching stage P, and acts upon all four of the bases of the transistors P_1 to P_4. It can only be effective, however, on the transistor P_1, as the transistors P_2, P_3 and P_4 are still blocked by too low an emitter potential. The impulse, amplified in the transistor P_1 and with its polarity reversed, then comes to the input of the section of the stage Q of the branching connection which contains the transistors Q_1 to Q_4. Of these transistors, the transistors Q_1, Q_2 and Q_4 are in the blocked condition, owing to the emitter potential being too low. Only the transistor Q_3 is at a working point, so that it alone can transmit the negative impulse arriving at its base, as an amplified positive impulse, to the branching stage U_3 consisting of the transistors T_9 and T_{10}.

These two transistors, with respect to their collector, base and emitter voltages, are biased in such a manner that they are normally non-conductive. The transistor T_9 can be put into a conductive condition transiently only by a negative impulse on its base; in the case of the transistor T_{10} a positive impulse upon the emitter is necessary in order to put the transistor transiently into a conductive condition.

The finally arriving positive impulse of the impulse train S will now therefore put the transistor T_{10} briefly into a conductive condition, so that this transistor delivers a current pulsation, which actuates the interpreting member K_6. If this interpreting member is a printing magnet of an electrical typewriter, the character selected by the impulse combination $- - + - +$ will be printed by it.

In order that the change-over of the selected transistors of the Q-stage may not already lead to an unintentional response of the transistors in the U-stage, the voltage e' on the transistors of the U-stage is first brought by the last impulse to that level at which these transistors can respond to an implified impulse coming from the branching connection.

The last impulse, which is passed by way of the counting-chain link N_5 consisting only of the diode D_5, also passes over the connection marked o at the left-hand bottom corner of FIGURE 3 to the restoring member R shown in FIGURE 4, which is likewise marked in FIGURE 2. This restoring member R comprises three transistors T_{11}, T_{12} and T_{13}, of which the transistors T_{11} and T_{12} are together connected as a mono-stable multivibrator known in itself. The diodes D_6 and D_7 take care that a positive impulse arriving at the point o acts upon the base of the transistor T_{12}, whereas a negative impulse acts upon the base of the transistor T_{11}. In both cases the mono-stable multivibrator is released, and to the collector of the transistor T_{12} is given an impulse X, which is represented in the right-hand top corner of FIGURE 4, and the duration of which is determined by a time-constant arrangement which consists of the adjustable resistance Wt and the condenser Ct.

The duration of the impulse X at the collector of the transistor T_{12} is so adjusted by the time-constant arrangement that the rear flank of the impulse occurs only when the printing of the sign in question is definitely completed. The impulse X is differentiated in the coupling condenser Cc, and conveyed in the form Y to the base of the transistor T_{13}, which is adjusted to its normal working point. Upon the arrival of the differentiated impulse Y upon its base, the transistor T_{13} is for a short time blocked by the second part of the impulse, and it then delivers to its collector a strong negative impulse Z. This impulse Z is given to the bases of all the counting-chain transistors; and the counting-chain transistors previously changed over are again set by this impulse into their original condition, that is, the blocked condition.

The voltages at the transistors of the branching connection are thereby also at the same time restored to their initial condition, so that all the transistors of this branching connection are blocked. The entire interpreting arrangement is then ready for the translation of a fresh train of impulses.

Finally FIGURE 5 shows in what manner the transistors (T_9 and T_{10} in FIGURE 3) of the U-stage of the branching connection can be replaced by simple diodes D_8 and D_9. To each of the output transistors Q_1 to Q_{16} of the Q-stage, diodes D_8 and D_9 polarized oppositely to one another are connected by way of a condenser C, these diodes each being connected with one of the interpreting members, in the present case, K_5 and K_6.

The last impulse, amplified in the P-stage and Q-stage, is therefore, according to its polarity, supplied to the interpreting member K_5 or K_6.

I claim:

1. An arrangement for translating binary-coded telegraph signals in the form of n-digit impulse-element combinations, which are composed of n successive individual impulses of positive or negative potential, particularly an arrangement for the control of teleprinter receivers, characterised by a counting chain connected to the feeding conductor for the impulse-element combinations to be translated, with counting-chain links each containing two bi-stable semi-conductive elements, one of which is controllable into a conductive condition by a positive impulse and the other by a negative impulse, each counting-chain link also containing a first outlet conductor which is influenced by the controlling electrodes of the two semi-conductive elements, and comprises two second outlets which are each influenced by only one semi-conductive element, by controllable impulse gates controlled from time to time by the voltage between a first outlet electrode of the counting-chain link to be controlled and a first outlet electrode of the preceding counting-chain link, so that the counting-chain links are switched over individually and successively, and further characterised by the feature that in the branching circuit, one outlet in each case of an element located in one group of switches is connected with the inputs of $2m$ elements of the following switch group, (m being a small integer) that each element has m inputs, that the inputs of all the elements of one switch group are connected with the $2m$ second outlet conductors of m successive counting-chain links, in such a way that each of the m inputs of an element are connected with one of the associated counting-chain links, that the inputs of the individual links of one group of switches are connected in a manner different from one another with the $2m$ second outlet conductors of the m counting-chain links, and that the first outlet of the last counting-chain link is connected with a switching element

for the purpose of controlling the latter, which is arranged between the input conductor of the signals and the inputs of the first group of switches, so that this switching element becomes conductive when the last counting-chain link is actuated, and that a device known in itself is provided which restores the arrangement into the initial position after the translation of an impulse-element combination.

2. An arrangement for the translation of binary-coded telegraph signals as claimed in claim 1, characterised by the feature that as selective switching elements in the branching circuit transistors are provided, which are switched on from time to time in pairs in forked branchings of the stages of the branching circuit, and are coupled to the bi-stable semi-conductive elements of the counting-chain link allocated to the associated stage of the branching circuit, in such a way that they are in a state of rest in a blocked position, and that only one transistor at a time of a pair of transistors is changed out of a blocked condition into a working condition in dependence upon the potentials of the coupling positions of the associated counting-chain link.

3. An arrangement for the translation of binary-coded telegraph signals as claimed in claim 1, characterised by the feature that as switching elements in the branching circuit, transistors are provided, and that the outlet of a switch element is connected each time with the four inputs of four associated switch elements in the succeeding group, that each switch element is provided with two input-control conductors, that all the input-control conductors of a group are so connected with the four second outlet conductors of two associated counting-chain links that in each case the two input-control conductors of a switch element are connected with the one outlet of the two associated counting-chain links, that the input-control conductors of the individual elements in one group are connected in ways different from one another with the outlet conductors of the counting chains, and that the working points of the switch elements are so selected that a switch element is actuated only when voltages of definite polarity are applied to both its inputs.

4. An arrangement as claimed in claim 1, characterised by the feature that when employing an odd number of impulse-sequence elements, the last group of the branching circuit comprises only switches interconnected in pairs, one of which becomes conductive at a positive input impulse and the other at a negative input impulse, and that a switching device is provided which from time to time conducts the last impulse of a sequence of impulse elements to the input of the branching circuit.

5. An arrangement as claimed in claim 3, characterised by the feature that when employing an odd number of impulse-sequence steps, the last group of the branching circuit comprises only switching elements interconnected in pairs, of which one becomes conductive upon a positive input impulse and the other upon a negative input impulse, and that a switching device is provided which in each case conducts the last impulse of a sequence of impulse steps to the input of the branching circuit.

6. An arrangement as claimed in claim 1, characterised by the feature that as translating members, magnets of a sign-printing appliance, particularly one with an electrical typewriter, are provided.

References Cited in the file of this patent

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