Dec. 19, 1950 L. A. THOMAS ET AL 2,534,387

MORSE CODE PRINTING SYSTEM

Filed Nov. 15, 1946 5 Sheets-Sheet 1

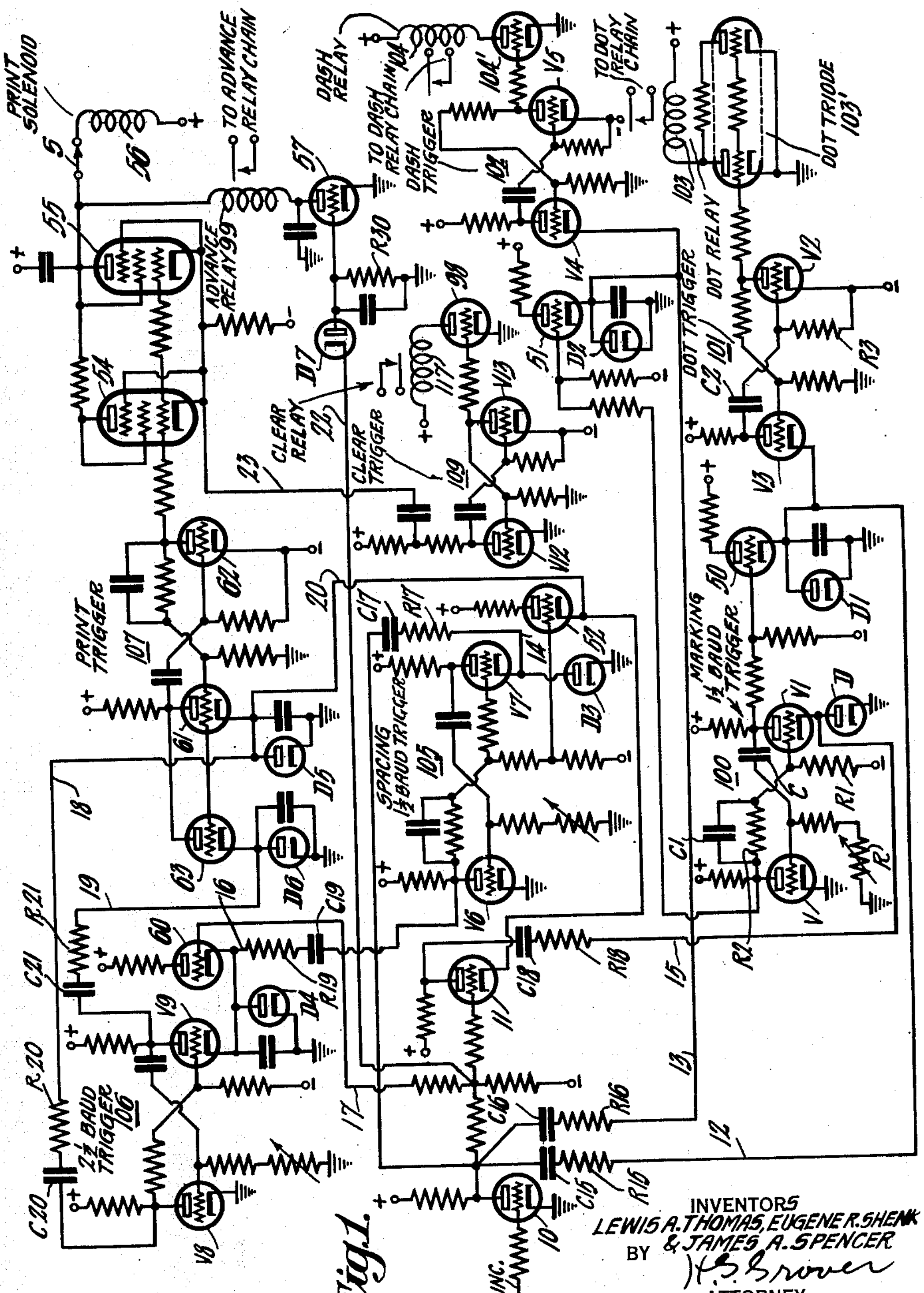

Fig.1.

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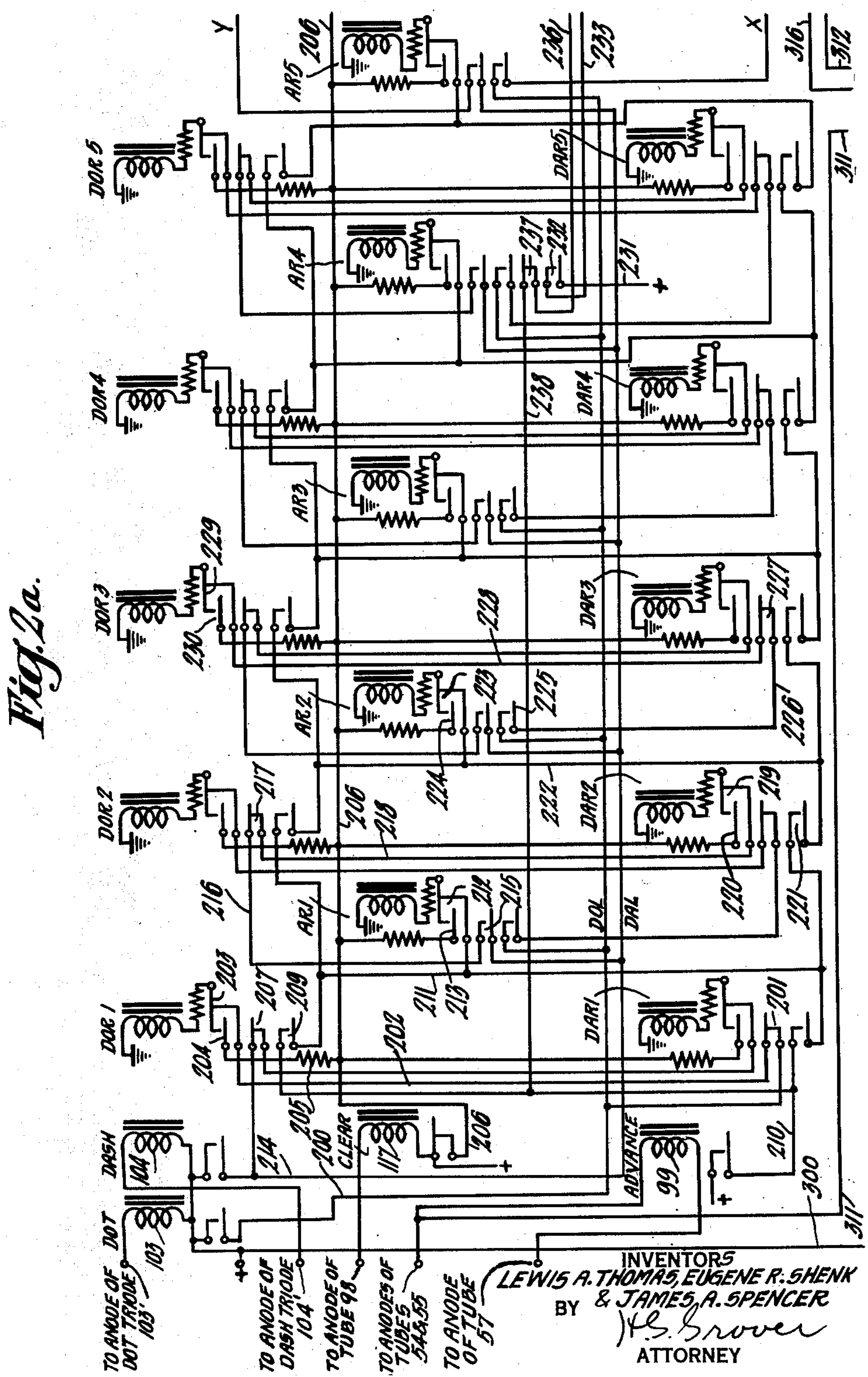
Filed Nov. 15, 1946 5 Sheets-Sheet 2

Fig. 2a.



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5 Sheets-Sheet 3

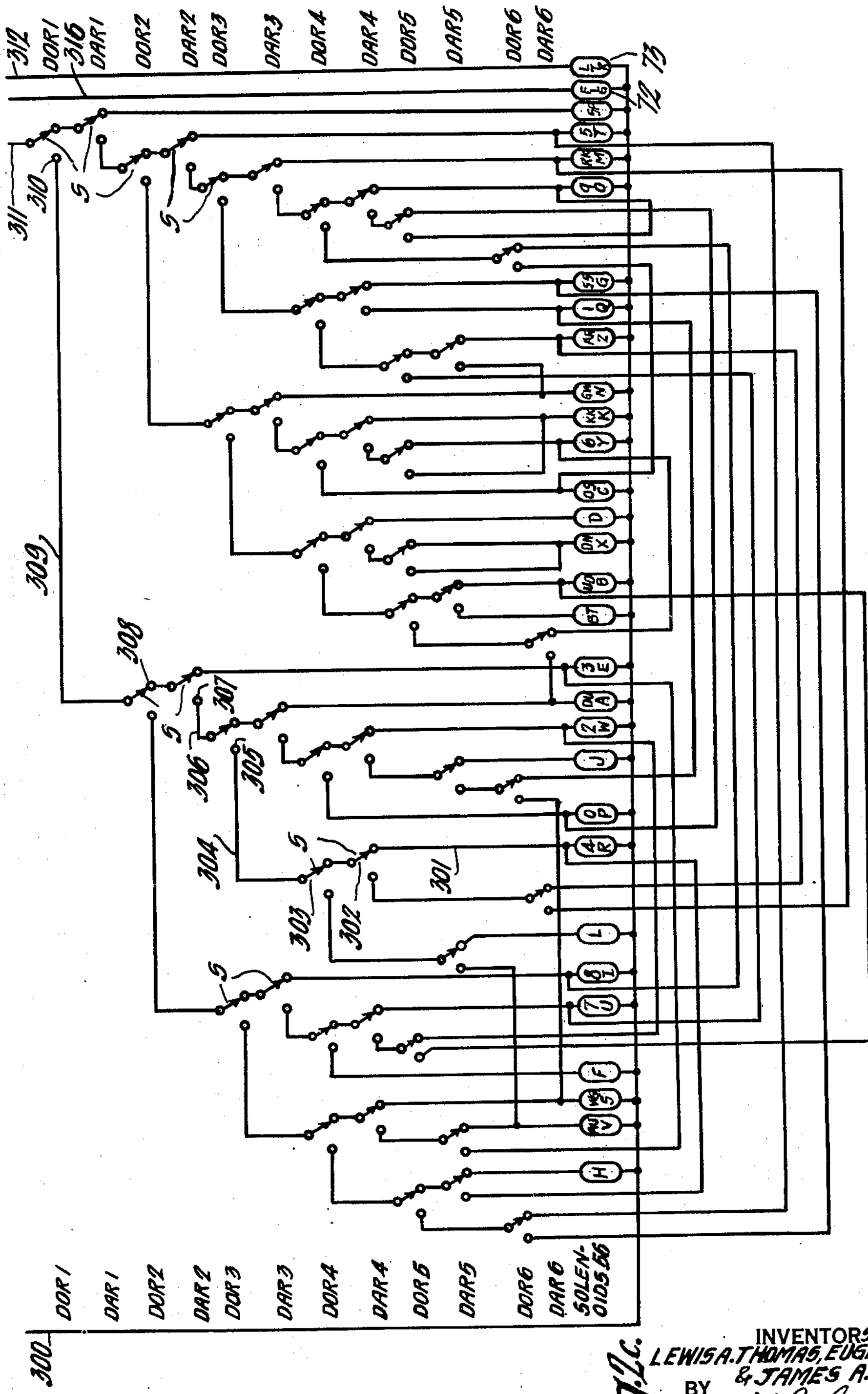

Fig. 2c.

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MORSE CODE PRINTING SYSTEM

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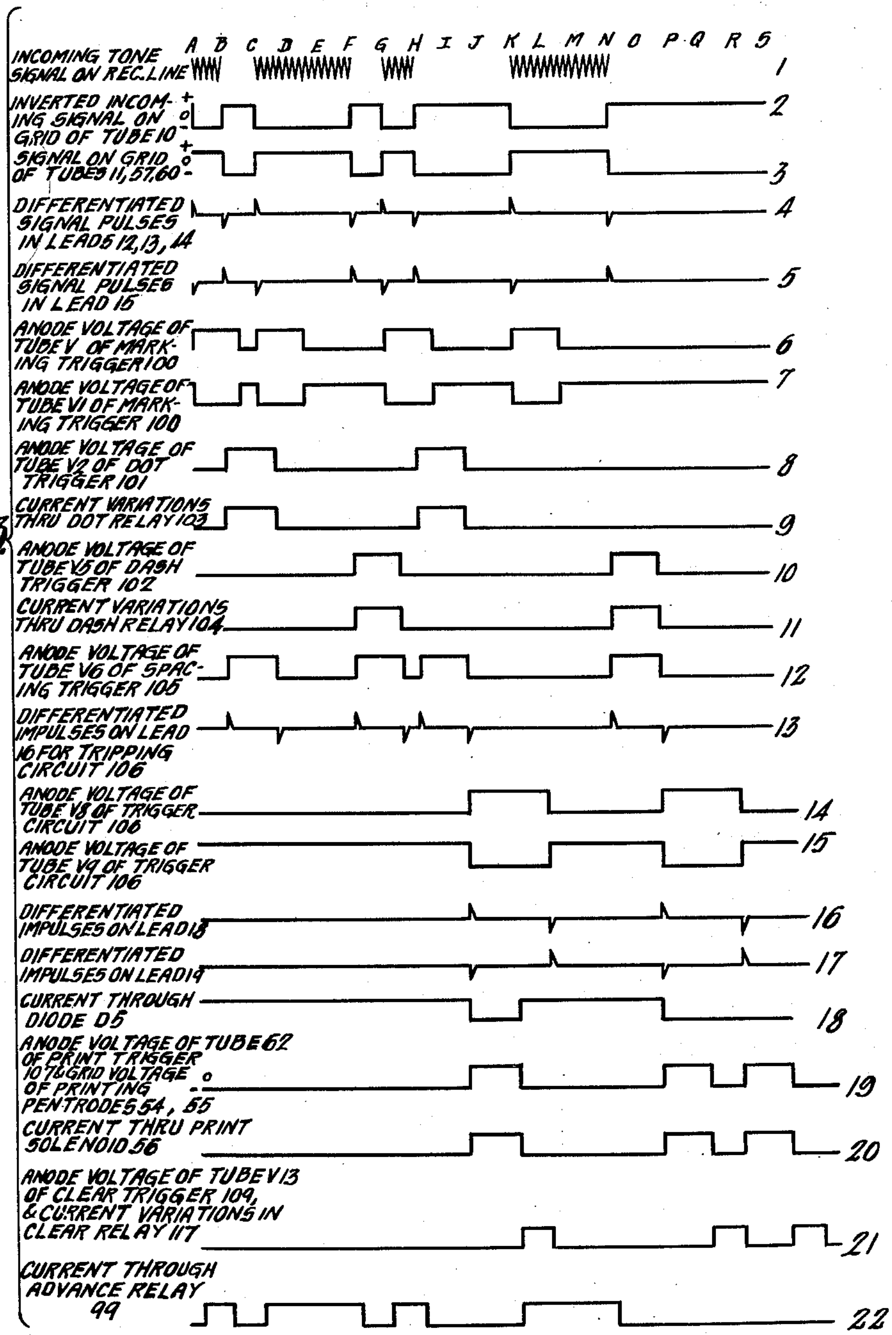

Fig. 3

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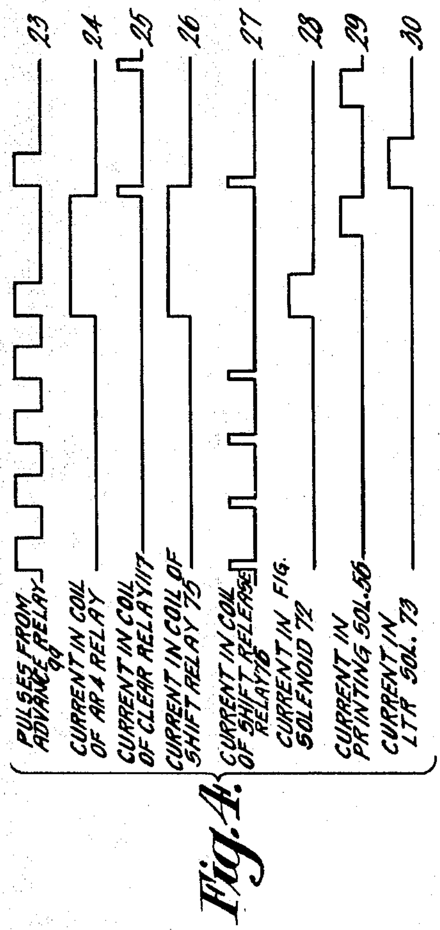
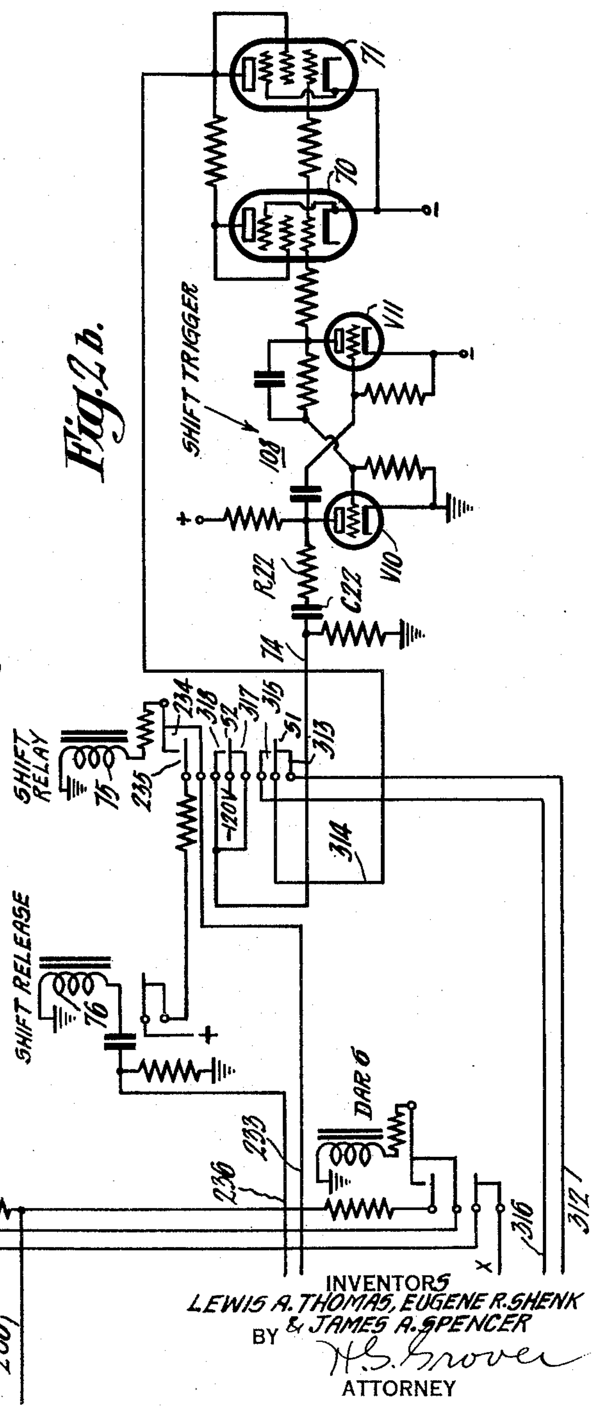
MORSE CODE PRINTING SYSTEM

Filed Nov. 15, 1946 5 Sheets-Sheet 5





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UNITED STATES PATENT OFFICE

2,534,387

MORSE CODE PRINTING SYSTEM

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Application November 15, 1946, Serial No. 709,992

21 Claims. (Cl. 178—26)

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This invention relates to electronic circuits for automatically transposing or converting signals or messages from one code into another, and particularly to such circuits for automatically transposing continental Morse telegraphic code signals into equal length printer code signals.

The continental Morse code employs dots and dashes for the various code combinations comprising the letters of the alphabet and symbols. Each dot is equivalent to a single baud or elemental time interval while the dash is equivalent to a 3 baud time interval. The term baud is used herein to refer to a unit of time and is in fact half of a dot cycle, the duration of the baud being determined by the keying speed. The dots and dashes are separated by spaces whose duration determines whether or not the preceding and succeeding character elements constitute part of a single letter, separate letters or separate words. A space of 3 bauds duration represents an inter-character or inter-letter space, while a space of 5 or more bauds represents a word space. The characters within a single letter are separated by an intra-letter or inter-element space of 1 baud duration. The letters and symbols of the Morse code are generally made up of unequal length code combinations of dots and/or dashes. The printer code on the other hand employs equal length code combinations for every letter of the alphabet and for every symbol. The code combinations of a printer code are composed of a plurality of equal length units or elements. The most common printer code employs 5 units for every code combination, while other printer codes employ 6 units, or seven units or more for each code combination.

Heretofore, in retransmitting intelligence in printer code from received continental Morse code signals, it has been the general practice to copy the received signal aurally or record the received signals on an inked tape, then transcribe the signals on a typewriter, and thereafter manually perforate a tape by means of a keyboard tape perforator, or operate a Teletype printer machine. Such an arrangement requires one or more operators, thus increasing the cost of operation, and in addition, is likely to introduce errors due to the human equation.

It is known that to translate Morse code signals into printer code signals by purely mechanical apparatus, requires apparatus that is both complicated and costly. Further, such known mechanical signal code converting arrangement requires a reperforated Morse tape for its controlling means.

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An object of the present invention is to provide an improved method of and means for automatically producing perforated telegraphic printer code tape directly from continental Morse code telegraphic signals.

Another object of the invention is to produce perforated telegraphic printer code tape from Morse code signals by mechanical and electronic means without the use of a human operator for reading the signals and perforating the tape.

Another object of the invention is to perform a code translation from Morse code to printer code by the use of electro-mechanical relays and simple electronic circuits, thereby avoiding intricate mechanical assemblages and errors due to the human equation.

Briefly stated, the present invention comprises apparatus which receives continental Morse code telegraphic signals, rectifies the same, actuates various electronic trigger circuits from these rectified signals and, by a gating operation, sorts the Morse signals into dots, dashes, intra-letter spaces, inter-letter spaces and inter-word spaces.

An advantage of the present invention is that there is no requirement that the incoming signal by synchronous, or in any way controlled from the receiving end. The translator apparatus of the invention accepts, without error, received signals varying in speed or weight, either one or a combination of both, to a total of ±20% from a predetermined mean or average speed or weight.

A more detailed description of the invention follows in conjunction with a drawing, wherein:

Fig. 1 illustrates the electronic translator circuit of the invention;

Figs. 2*a*, 2*b* and 2*c*, taken together, illustrate the relay counting chain for use with the circuit of Fig. 1;

Fig. 3 is a series of curves which represent voltage and current variations at different points in the system of Fig. 1, given for the purpose of explanation; and

Fig. 4 is a series of curves given in explanation of the operation of the shift mechanism of the invention.

Referring to Fig. 1, there are shown various trigger circuits for sorting the dots, dashes, and spaces of the incoming Morse code signals and other trigger circuits for performing the printing function, the clearing function and the case shift function.

The incoming or received continental Morse code signal, which may be tone, is represented in line 1 of Fig. 3. This signal is represented by dots and dashes separated by spaces. The dots cover the intervals between times A and B, and between G and H, while the dashes cover the intervals between C and F and K and N. The dot is shown as having a duration of one baud while the dash is shown as having a duration of three bauds. The spaces appearing in the intervals B—C and F—G are each of one baud duration and are inter-element spaces. The space covering the interval H—K is three bauds in length and represents an inter-character space, while the space covering the time interval N—S extends over a duration of five bauds and represents a word space.

The tone signal of line 1 is rectified by suitable apparatus (not shown) to produce direct current pulses of mark and space, as shown in line 2 of Fig. 3. The mark of line 2 is of negative polarity while the space is of positive polarity. Thus the direct current pulses of line 2 are applied to the incoming line INC which connects with the grid of the amplifier and inverter vacuum tube 10. The output of tube 10, appearing at its anode, comprises pulses of the same wave form as the input but of reversed polarity. This output is applied to the grid of the amplifier-inverter vacuum tube 11 and is shown in line 3 of Fig. 3. The output of tube 10 is also applied to leads 12 and 13 through differentiator circuits R15, C15 and R16, C16, respectively, and also to lead 14 through differentiator circuit R17, C17. The same output signal from amplifier inverter tube 10 is also applied to leads 17 and 22. The output of amplifier-inverter tube 11 which has the same polarity and wave shape as the pulses shown in line 2 of Fig. 3 is applied to lead 15 through differentiator circuit R18, C18.

In order to sort the dots and dashes, there is provided a self-restoring marking trigger circuit 100 composed of vacuum tubes V and V1 whose grids and anodes are interconnected regeneratively. This trigger circuit has one degree of electrical stability; namely, a stable state in which tube V is normally conducting and tube V1 non-conducting, and an active state in which tube V is non-conducting and tube V1 conducting. The time duration in which the trigger circuit 100 remains in its active state is determined to a large extent by the time constants of the condenser C and variable resistor R in series with a second resistor connected between ground and the grid of tube V. The anode of tube V is connected to the grid of tube V1 through a condenser-shunt-resistor combination C1, R2. The grid of tube V1 is connected through a resistor R1 to the negative terminal of a source of unidirectional potential, −110 volts. In circuit with the cathode of tube V1 is a diode D. The time constants of the trigger circuit 100 have such values that it will remain in the active state when triggered or fired for a time duration of one and one-half bauds. In order to fire or activate the trigger circuit 100, there is required upon lead 15 a negative impulse which is applied to the cathode of tube V1. It will be evident that the application of a negative impulse to the cathode of tube V1 is equivalent to the application of a positive impulse to the grid of tube V1.

In circuit with the anode of tube V1 is a triode vacuum tube 50 whose grid is connected to the anode of V1 and whose cathode is connected to ground through a diode D1 shunted by a condenser. Tube 50 is normally conducting; that is, it passes current during the time the trigger circuit 100 is in its stable state.

In circuit with the anode of tube V is a vacuum tube triode 51 whose grid is connected to the anode of V and whose cathode is connected to ground through a diode D2 shunted by a condenser. Tube 51 is normally non-conducting during the stable state of the trigger 100.

The current passing conditions of tubes 50 and 51 reverse themselves when the trigger circuit 100 is activated. Stated in other words, when tube V1 becomes conducting, a negative pulse from the anode of this tube will be applied to the grid of tube 50 and render tube 50 non-conductive. Similarly, when tube V becomes non-conducting, a positive pulse from the anode of this tube will be applied to the grid of tube 51 and render tube 51 conducting.

In circuit with the cathode of tube 50 and also in circuit with lead 12 is a self-restoring dot trigger 101 comprising vacuum tubes V2 and V3. Tube V2 is normally conducting and tube V3 normally non-conducting during the stable state of the trigger 101 and the current passing conditions of tubes V2 and V3 are reversed during the active period of the trigger. The time duration of the active period of dot trigger 101 is determined in a large measure by the time constants of dencer C2 and resistor R. This active period is just sufficient to actuate a dot relay 103 in circuit with a dot dual triode vacuum tube 103′, the latter having its grid connected to the anode of tube V2.

In circuit with the cathode of tube 51 is a self-restoring dash trigger 102 comprising tubes V4 and V5. Tube V5 is normally conducting and tube V4 normally non-conducting in the stable state of this trigger and the current passing conditions of these two tubes are reversed in the active state. The operation of this dash trigger is similar to the operation of the dot trigger 101, and the active time of the dash trigger 102 is just sufficient to operate the dash relay 104 in circuit with dash vacuum tube triode 104′ whose grid is connected to the anode of tube V5.

The manner in which the marking trigger circuit 100 operates to cause either the dot trigger 101 or the dash trigger 102 to operate will now be given with particular reference to the curves of Fig. 3: The impulses appearing on lead 15 in circuit with the cathode of tube V1 of trigger circuit 100 are shown in line 5 of Fig. 3. These impulses are of relative positive and negative polarity and result from the differentiation of the square wave pulses in the output of tube 11, shown in line 2. Since it requires a negative impulse to activate or trip trigger circuit 100, it will be seen from an inspection of line 5 (Fig. 3) that such a negative impulse appears at the start of a mark at time A. This negative impulse will activate trigger 100 which will change from its stable to its active condition and remain in the active condition for a period of one and one-half bauds. Any positive impulse appearing on lead 15 will be absorbed by the diode D and has no effect on the trigger circuit 100. The anode voltage wave forms of tubes V and V1 of trigger circuit 100 are shown in lines 6 and 7 of Fig. 3. Thus, referring to line 6 of Fig. 3, it will be seen that the trigger circuit 100 is activated at time A and remains activated for one and one-half bauds until a time between B and C, at which time the trigger circuit will be restored to normal. At times C, G and K, corresponding to a position at which negative impulses appear in lead 15, line 5 of Fig. 3, the trigger circuit 100 will again be activated.

During the time trigger circuit 100 is in the active state, tube 50 will be non-conducting. If, during this time, a negative impulse appears on lead 12, this negative impulse will be sufficient to activate the dot trigger 101. The negative impulses in lead 12 appear at the end of the mark signals, and are shown in line 4, Fig. 3. The positive impulses in lead 12 have no effect on the circuit due to their absorption by diode D1 in the cathode circuit of tube 50. Thus, a positive impulse appearing on lead 12 will cause tube D1 to conduct and dissipate the pulse. It will thus be seen that the dot trigger is fired solely when the end of mark occurs during the active period of marking trigger 100. The anode voltage of tube V2 of dot trigger 101 and the corresponding current variations through dot relay 103 are shown in lines 8 and 9, respectively, Fig. 3. The dot trigger 101 cannot be fired or activated when tube 50 is conducting, due to the unfavorable division of input tripping pulse voltage between diode D1 and resistor R15.

The negative impulses necessary to operate the dash trigger 102 and hence the dash relay 104 appear in lead 13 and are shown in line 4 of Fig. 3. However, these negative impulses in lead 13 cannot activate the dash trigger 102 during the time tube 51 is conducting, and since tube 51 is conducting for the entire active time of trigger 100, it will be seen that the dash trigger 102 can operate only after the restoration of the trigger 100 to normal. Since trigger circuit 100 has an active period of one and one-half bauds, which is a time interval longer than a dot, it will be clear that the dash trigger 102 can only operate when an incoming dash signal element is received. Thus, referring to line 4, the first negative impulse which operates the dash trigger 102 occurs at the end of the first dash at time F, at which time trigger circuit 100 is in its stable state. The next negative impulse for operating the dash trigger 102 occurs at the end of the second dash element at time N, at which time trigger 100 is again in its stable state. The anode voltage curve for the dash trigger 102 and the corresponding current variations through the dash relay 104, are shown in lines 10 and 11, respectively. To summarize, the dot trigger 101 and the dot relay 103 are operated at the end of every dot, while the dash trigger 102 and the dash relay 104 are operated at the end of every dash element. Actually, the dot trigger 101 will operate at the end of the dot regardless of whether this dot is less than a baud or greater than a baud, provided it is less than one-half bauds; while the dash trigger 102 will operate when the mark element or dash is longer than one and one-half bauds.

The trigger circuit 105 is known as the spacing trigger circuit and is of the self-restoring type similar in operation to the trigger circuit 100. It comprises two vacuum tubes V6 and V7, tube V6 being normally conducting and tube V7 normally non-conducting in the stable state, and vice versa in the active state. The active period for the trigger circuit 105 is one and one-half bauds. This trigger circuit is fired from negative impulses appearing in lead 14, shown in line 4 of Fig. 3. These negative impulses for firing or activating trigger circuit 105 appear at the end of every mark. The anode voltage wave form of tube V6 of the spacing trigger circuit 105 is shown in line 12 of Fig. 3. The voltage wave form for the anode of tube V7 is not shown in Fig. 3 but is the inverse of that shown in line 12. It will be noted from an inspection of line 12 (Fig. 3) that the trigger circuit 105 is activated at times B, F, H and N. When trigger circuit 105 fires, it applies a positive pulse to the grid of a normally non-conducting tube 52 and causes tube 52 to conduct for the duration of the active period of the trigger circuit. When tube 52 conducts, there will be applied a positive pulse from the cathode of tube 52 via lead 20 to the anode of diode D5 in circuit with the print trigger circuit 107. It should be noted at this time that the cathode of the amplifier-inverter tube 11 is also connected directly to lead 20 and hence to the anode of diode D5. During marking periods, the pulses applied from the cathode of amplifier-inverter 11 to lead 20 are of positive polarity. Thus it will be seen that during marking intervals and also during the time when the spacing trigger circuit 105 is activated there is always a positive pulse on lead 20 to cause diode D5 to conduct. When diode D5 conducts, it prevents the activation of the printing trigger 107 from impulses on lead 18, as will appear hereinafter.

To properly sort out the spaces of the incoming Morse code signals, there is provided another self-restoring trigger circuit 106 which is similar in operation and arrangement to the spacing trigger circuit 105 and the marking trigger circuit 100 except for the fact that the active period of the trigger circuit 106 is two and one-half bauds. This trigger circuit comprises vacuum tubes V8 and V9, the former being normally conductive and the latter normally non-conductive in the stable state, and vice versa in the active state. In circuit with the cathode of tube V9 there is provided a diode D4 and also a vacuum tube 60 whose cathode is connected through lead 16 and differentiator circuit R19, C19 to the anode of tube V6 of the spacing trigger circuit 105. The grid of tube 60 is connected to lead 17 which extends to the anode of the amplifier-inverter tube 10. The signal which appears on lead 17 and the grid of tube 60 is shown in line 3 of Fig. 3. Tube 60 is conducting on the marking signals and non-conducting on the spacing signals. Thus, tube 60 is conducting between A and B, between C and F, between G and H, and between K and N. During the time tube 60 is conducting, there is a positive potential on the anode of diode D4 which causes this diode to conduct and hence prevent the activation of trigger circuit 106 through lead 16. It will thus be seen that the only time trigger circuit 106 can operate is during the spacing intervals when tube 60 is non-conducting. Trigger circuit 106 is activated from its stable to its active state solely upon the restoration of spacing trigger 105 to its stable state. Since lead 16 is connected to the anode of tube V6 of trigger circuit 105, it will be seen that when the spacing trigger circuit 105 restores itself to normal after one and one-half bauds in the active state, there will be a negative pulse on the anode of tube V6 which, when differentiated by R19, C19, will cause a negative impulse to appear on lead 16 to fire or activate trigger circuit 106. The impulses resulting from the differentiation of the negative pulse on the anode of tube V6 of trigger circuit 105 are shown in line 13 of Fig. 3.

The function of the spacing trigger circuit 105 is solely to delay the operation of the two and one-half baud trigger circuit 106. Since the trigger circuit 106 can operate only at the restoration of the trigger circuit 105 and in the absence of a mark, it will be seen that the trigger circuit 106 operates one and one-half bauds after the end of a mark, or one and one-half bauds after the beginning of a space, because the trigger circuit

105 commences its active period at the end of a mark or at the beginning of a space.

The anode voltage wave forms for the tubes V8 and V9 of the trigger circuit 106 are shown in lines 14 and 15 of Fig. 3. It will be seen that the first negative impulse on lead 16 (line 13, Fig. 3) capable of operating trigger circuit 106 occurs at a time between I and J, inasmuch as this time is during a spacing interval and at the end of the active period of the trigger circuit 105. (Note line 12, Fig. 3.) The next time trigger circuit 106 is fired is at a time between O and P, as will be seen from an inspection of line 14, Fig. 3.

The anodes V8 and V9 of the trigger circuit 106 are connected through differentiator circuits R20, C20 and R21, C21 to leads 18 and 19 respectively. The negative impulses appearing on lead 19 resulting from the differentiation of the output pulses from tube V9 on the activation of trigger circuit 106 are utilized to activate the self-restoring print trigger circuit 107 at these times. The negative impulses appearing on lead 18 resulting from the differentiation of the output pulses from tube V8 on the restoration of trigger circuit 106 are utilized to activate the trigger circuit 107 whenever a marking signal has not occurred during the active time of trigger circuit 106. The print trigger 107 is similar in operation to the self-restoring trigger circuits 101 and 102. Print trigger 107, however, comprises three vacuum tubes, 63, 61 and 62. Tube 62 is normally conducting and tubes 63 and 61 normally non-conducting in the stable state and vice versa in the active state. In the cathode circuit of vacuum tube 63 is a diode D6. In circuit with the cathode of tube 61 is the diode D5, which, when conducting, prevents the print trigger circuit 107 from becoming activated by negative impulses on lead 18. The impulses which appear in leads 18 and 19 are shown in lines 16 and 17 of Fig. 3. The current variations through diode D5 are shown in line 18 of Fig. 3. The anode voltage wave form of tube 62 of the print trigger 107 is shown in line 19 of Fig. 3. At the risk of repetition, it should be observed that the print trigger circuit 107 cannot operate with a negative impulse on lead 18 resulting from the restoration of trigger circuit 106 to its stable state if a mark has occurred during the active period of trigger circuit 106. This results from the locking action of tubes 11 and 52 in causing D5 to conduct and preventing the print trigger circuit 107 from operating. During the mark, tube 11 is conducting, and applies a positive potential through lead 20 to cause diode D5 to conduct. An inspection of curves 16, 17, 18 and 19 of Fig. 3 will show that the print trigger circuit 107 becomes active solely during the time there is no current through the diode D5, and this activation of the printing trigger occurs under this condition upon the application of a negative impulse on leads 18 or 19.

In circuit with the output of the print trigger 107, there is provided a pair of normally cut-off printing pentode tubes 54 and 55. The anodes of these two pentode tubes are connected through a permutation of selecting switches S to any of a plurality of solenoids 56. In practice, there are thirty-two such solenoids 56, one for each character key on the printer perforator and approximately fifty selecting switches S under the control of counting relays. There is a permutation of selecting switches for each Continental Morse character to be selected.

When the print trigger 107 becomes activated, the tube 62 will become non-conducting and will pass a positive pulse through its anode to the grids of pentodes 54 and 55, thus causing these two tubes to pass current for the duration of the active period of the print trigger circuit 107, and hence cause the actuation of the proper printing solenoid 56. The active time of print trigger 107 is just sufficient to operate solenoid 56.

In circuit with the cathodes of the pentodes 54 and 55 is a self-restoring clear trigger circuit 109 comprising vacuum tubes V12 and V13. Clear trigger circuit 109 operates in the same manner as trigger circuits 101 and 102. When conduction ceases in tubes 54 and 55, the cathodes of these two tubes assume a negative potential, −120 volts, and apply a negative pulse through lead 23 to the grid of tube V13, firing the trigger circuit 109. In the stable state of trigger circuit 109, tube V13 is normally conducting and tube V12 normally non-conducting and the current passing conditions of these two tubes are reversed in the active state. In circuit with the anode of tube V13 is the grid of a triode vacuum tube 98 whose anode is connected to the winding of clear relay 117. Tube 98 is normally non-conducting and is caused to conduct when trigger circuit 109 is activated. The function of the clear relay 117 is to re-set all of the relays of the counting chain to be described later. The clear trigger circuit 109 is activated when the tubes 54 and 55 are cut-off due to the restoration of the print trigger circuit 107.

The current variations through the printing solenoid 56 are represented by the wave form of line 20 of Fig. 3. The anode voltage of tube V13 on clear trigger circuit 109 and the current variations in the winding of clear relay 117 are shown in line 21 of Fig. 3. It will be noted that the clear trigger circuit and the clear relay operate only at the termination of the operation of the printing solenoid and that this clear trigger circuit and clear relay are restored to their normal conditions prior to the application of another printing pulse.

In summarizing the sorting or gating operation of the system of the invention, it will be noted that the dot trigger 101 is operated when there occurs a mark element of one baud duration (or less than one and one-half bauds) and that the dash trigger circuit 102 is operated when there occurs a mark of three bauds duration (or more than one and one-half bauds). Similarly, the trigger circuit 105 is operated but nothing else when there occurs a space element of one baud duration (or less than one and one-half bauds). If there occurs a space of three bauds duration (or more than one and one-half bauds), then the restoration of the trigger circuit 105 will operate trigger circuit 106, whose operation in turn will activate trigger circuit 107 and cause a single printing operation over a selected solenoid 56. Since trigger circuit 106 cannot operate until the restoration of trigger circuit 105, and trigger circuit 105 is activated for one and one-half bauds duration, then it will be obvious that trigger circuit 106 does not start until one and one-half bauds of space elapse. Inasmuch as the active time of trigger circuit 106 is two and one-half bauds duration. It will be evident that it does not restore itself until one and one-half plus two and one-half (or four) bauds after the start of a space. When trigger circuit 106 restores itself, it will operate print trigger circuit 107 via lead 18, provided no marking signal has intervened to lock the print trigger circuit 107 in its stable position.

Actually, the print trigger circuit 107 is operated immediately after one and one-half bauds of space, when trigger circuit 106 is activated, and this occurs via the impulse on lead 19. The print trigger circuit 107 again operates after four bauds of space, under the conditions set forth above. The system thus functions promptly to identify inter-character and word spaces at a predetermined time before the spaces are completed, hence enabling the re-setting of the print solenoids and relay chains in ample time for the acceptance of a new Morse code combination.

Similarly, the dot trigger circuit functions immediately after the receipt of a dot, even though this dot may have a weight more or less than one baud, provided the weight is less than one and one-half bauds. Also, the dash trigger circuit functions immediately after the end of a mark, so long as this mark exceeds one and one-half bauds no matter what the duration of this mark may be. It will thus be evident that the system provides a high degree of tolerance in weight (percentage mark-to-space) and speed of signal elements constituting each code combination.

An advance relay 99 is provided which operates via lead 22 and triode 57, and repeats the marking signal. The winding of advance relay 99 is in circuit with triode 57 whose grid is connected to ground through resistor R30 and to the anode of diode D7. During marking, which causes the application of a positive pulse to lead 22, the diode D7 will be non-conductive, at which time the grid of tube 57 will be at ground potential through resistor R30, causing tube 57 to conduct and energize the winding of advance relay 99. In the absence of a marking signal on lead 22, diode D7 will be conducting because the anode of this diode will be positive relative to its cathode, as a result of which the IR drop through resistor R30 is of sufficient magnitude to bias the tube 57 to cut-off and interrupt the flow of current through advance relay 99. It should be noted that the anode of tube 57 obtains its positive polarizing potential through the winding of advance relay 99 and through selector switches S and the winding of the selected print solenoid 56. During the printing operation, the drop in voltage through the printing solenoid is of such a magnitude as to prevent the energization of the advance relay 99. This interlocking action prevents the setting up of a false character in the relay chain during the printing operation. The current variations through the advance relay 99 are shown in line 22 of Fig. 3. An inspection of line 22 and line 3 of Fig. 3 will show them to have substantially similar wave forms.

Fig. 2 shows the chain of relays for causing the operation of the various printing solenoids 56, and also shows other relays together with an electronic circuit for changing from lower case (letters) to upper case (figures). There are six dot relays DOR1 to DOR6 inclusive and six dash relays DAR1 to DAR6 inclusive. These relays constitute a counting chain. Relay DOR1 and dash relay DAR1 form one pair of relays in the counting chain, and relay DOR2 and relay DAR2 form another pair in the counting chain etcetera, while relay DOR6 and relay DAR6 form the last pair in the counting chain. There is also provided another chain of relays, relay AR1 through relay AR5, called the advance relay chain. These last relays are operated from the advance relay 99. The advance relay chain is, in effect, a stepping relay causing the dot or dash signals to be switched from one pair of relays in the dot and dash chain to another pair or relays in the chain. The relays DOR1 through DOR6 are operated from the contacts of the dot relay 103, while the relays DAR1 through DAR6 are operated from the contacts of the dash relay 104.

In order to simplify the drawing, certain contacts on the relays, DOR1 through DOR6, and DAR1 through DAR6, have been illustrated on Fig. 2c, and these perform the permutations which select the proper printer solenoids 56. The various contacts on the relays DAR1 through DAR6 and DOR1 through DOR6 which perform the permutations for operating the selected solenoids 56 are represented by the reference character S.

A description of the operation of the chain relay system of Fig. 2 will now be given: From what has gone before, it will be understood that the dot relay 103 operates every time a dot marking signal has been identified, while dash relay 104 operates every time a dash marking signal has been identified, and advance relay 99 operates every time a marking signal occurs. Dot relay 103 and dash relay 104 operates at the end of every dot or dash respectively, while advance relay 99 operates during the marking signal whether a dot or a dash. Solenoid 56 operates after 1½ bauds of space or after the spacing signal has been identified as either an inter-letter space or word space.

The operation of dot relay 103 closes its contacts and causes the application of a positive potential to lead 200, and this positive potential follows a path through break contacts 201 of relay DAR1, lead 202 and break contacts 203 to the winding of relay DOR1, thus energizing relay DOR1 and causing this relay to lock up over its make contact 204 and open the break contacts 203. The contact 204, for locking relay DOR1 in its operative position, is connected through a resistor 205 to bus 206 which, in turn, is connected to a source of positive potential through the break contacts of the clear relay 117. It should be noted that this common lead or bus 206 furnishes the locking or holding potential for all the relays DOR1 through DOR6, DAR1 through DAR6, and AR1 through AR5.

The operation of relay DOR1 opens the break contacts 207 which form a path for operating relay DAR1 in the event dash relay 104 should operate.

The operation of relay DOR1 also closes a path over a pair of make contacts 209 to enable the operation of relay AR1 over a circuit extending from the make contacts of advance relay 99, lead 210, through the make contacts 209, lead 211, break contacts 212 of relay AR1 and the winding of this relay. Since the advance relay 99 operates during every marking signal, it will thus be evident that the occurrence of the second marking signal, whether a dot or a dash, will operate relay AR1 and cause AR1 to lock up over its make contact 213 and holding bus 206. The first marking signal, whether a dot or a dash, in any letter received in any code combination, cannot operate relay AR1 because of the fact that the contacts on relays DOR1 and DAR1 for operating relay AR1 are open.

The operation of the dash relay 104, assuming the receipt of a code combination as indicated in line 1 of Fig. 3, will close the contacts of the dash relay 104 and apply a positive potential to lead 214 and thus cause the operation of relay DAR2 over a path extending through lead 214, make contacts 215 of relay AR1, lead 216, break contacts 217 of relay DOR2, lead 218, break contacts 219 of relay DAR2 to the winding of this relay. When relay DAR2 operates it will lock up over its make contact 220 and holding bus 206.

The closure of DAR2 prepares a path for the operation of relay AR2 upon the operation of advance relay 99 on the third marking signal and opens the circuit from lead 200 on which a pulse might otherwise operate relay DOR2.

The occurrence of the third marking signal will cause the advance relay 99 to operate relay AR2 over a path extending from the make contacts of the advance relay 99, lead 210, make contacts 209 of operated relay DOR1, lead 211, make contacts 221 of operated relay DAR2, lead 222 to the break contacts 223 of relay AR2, and to the winding of this relay. The operation of relay AR2 causes it to lock up over its make contact 224, and prepares a path for the operation of relay DOR3 or DAR3 depending upon whether or not this third marking signal is a dot or a dash. If this third marking signal is a dot as shown in line 1 of Fig. 3, then the operation of dot relay 103 at the end of this mark will cause the operation of relay DOR3 over a path extending from lead 200, make contacts 225 of operated relay AR2, lead 226, break contacts 227 of relay DAR3, lead 228, to the break contacts 229 and the winding of relay DOR3. Relay DOR3, upon being energized, locks up over its make contact 230.

The next marking signal will operate advance relay 99 and cause the operation of relay AR3 provided, prior to this time, the space is not sufficiently long enough to cause the printing operation. If the signal of line 1 of Fig. 3 is being received, a printing operation will occur before the receipt of another marking signal, due to the fact that the space between times H and K is three bauds long. Since the first three marking elements of line 1 of Fig. 3 represent the letter R, a study of Fig. 2c of the permutation switching contacts S will show that switching contacts for relay DOR1, DAR2 and DOR3 will be operated to the left (which is the energized position) and prepare a path for the operation of the printing solenoid 56, represented by the letter R. The path for printing solenoid R is traceable from the plus 120 volts lead 300, through the printing solenoid R (and the numeral 4), lead 301, unoperated or right contacts 302 of relay DAR4, unoperated contact 303 of relay DOR4, lead 304, operated or left contact 305 of relay DOR3, lead 306, operated contact 307 of relay DAR2, unoperated contact 308 of relay DOR2, lead 309, operated contact 310 of relay DOR1, and lead 311 to the anodes of printing pentode vacuum tubes 54 and 55.

Assuming that a fourth marking signal had followed the first three marking signals and after a spacing interval of only one baud, then there would not have been a printing operation, and the advance relay 99 would have caused the operation of advance relay AR3 which would have prepared a path for the operation of relay DOR4 or DAR4 depending upon whether or not the fourth marking pulse was a dot or a dash. Similarly, it will be obvious that additional marking signals will operate relays AR4 and AR5 preparing the paths for the operation of relays DOR5 and DAR5, DOR6 and DAR6 respectively, depending upon whether these fifth and sixth marking elements are dots or dashes.

The operation of the case shift feature of the invention will now be described: Many of the

solenoids 56, it will be observed, have both a letter and a numeral shown. On the printer perforator these numerals appear on the same key as the corresponding letters, that is, as the upper case character of the letter. Thus a Morse code combination for the numeral 4 must operate the same perforator key, and therefore the same solenoid as the letter R. However, the operation of the solenoid for the numeral must be preceded by the figure shift combination. In order to assure that the following character will be registered in lower case, should it be a letter and not a numeral, a letter shift combination must follow the printing of every numeral. The letter code combinations include at most only four marking signals, while the numeral (upper case) code combinations include at least five marking elements and sometimes six marking elements. When more than four marking elements are received, the figure solenoid (upper case) 72 will operate due to the operation of shift relay 75 and the shift trigger 108. This occurs as follows: The receipt of a fifth marking element causes the advance relay 99 to operate relay AR4. AR4 operates to lock up in the manner described for relays AR1, AR2 and AR3. The operation of relay AR4 prepares a path for the operation of relays DOR5 and DAR5 depending upon whether this fifth marking element is a dot or a dash. In addition relay AR4, in operating, operates the shift relay 75 over a path including a source of positive potential on lead 231, the make contacts 232 of relay AR4, lead 233, and break contacts 234 and winding of the shift relay 75. When the shift relay 75 operates, it locks up over its make contact 235 and the break contacts of shift release relay 76.

When shift relay 75 is unoperated or in its normal position, it should be noted that a path is closed to the letter solenoid 73 over a path including lead 300 on which there appears a voltage of +120 volts, the winding of letter solenoid 73, lead 312, lower break contact 313 and armature S1 of shift relay 75, and lead 314 extending to the anodes of pentode vacuum tubes 70 and 71. Pentodes 70 and 71 only operate in response to the operation of shift relay 75 as will appear hereinafter. Thus, while letter code combinations only are being received, the letter solenoid 73 and the shift relay 75 will be unenergized and the circuit will be on the letter shift or lower case position. When numeral or figure signals are being received, which is characterized by more than four marking signals, the operation of relay AR4 by the fifth marking signal will cause the operation of relay 75 which locks up. The operation of shift relay 75 will cause armature S1 to disengage break contact 313 and cause armature S1 to engage make contact 315, thus closing a path through the figure solenoid 72 over lead 316.

It should be noted that lead 74 which extends to the trigger circuit 108 is connected through break contact 317 and its associated armature S2 to the negative terminal of a battery of 120 volts. Thus when relay 75 operates, the armature S2 disengages break contact 317 and travels toward and engages make contact 318. During the travel time of the armature S2 from the break contact 317 to the make contact 318 a pulse of relatively positive voltage is impressed on lead 74 due to the momentary removal of the minus 120 volts. This pulse has no effect on the trigger circuit. When, however, the armature S2 of the shift release relay 75 engages the make contact 318, there is applied a negative voltage pulse to lead 74. This negative pulse is differentiated by condenser C22 and resistor R22 to produce a negative impulse of a magnitude to trip or activate the trigger circuit 108. The shift trigger circuit 108 is similar in operation to the print trigger circuit 107 of Fig. 1 and comprises vacuum tubes V10 and V11. Tube V10 is normally non-conducting and V11 is conducting in the stable state of the trigger circuit, and the current passing conditions of these two tubes are reversed in the active state. When the shift trigger circuit 108 is activated, tube V11 will cease conducting and pass a positive pulse to the grids of pentode tubes 70 and 71, thus causing these two pentode tubes to pass current and complete the path to operate the figure solenoid 72. The shift trigger circuit 108 has a time constant which causes it to remain in the active state for a time interval sufficient to operate solenoids 72 or 73.

At the end of the Morse code combination constituting the particular figure or numeral being received, print trigger circuit 107 will operate and cause the operation of the desired printing solenoid 56. After the termination of operation of the selected printing solenoid 56, the clear relay 117 will operate through the clear trigger circuit 109, as a result of which the break contacts on the clear relay 117 will open and the positive potential on the holding or locking bus 206 for the chain relays will be removed, causing all of the chain relays to become de-energized and restored to normal. When relay AR4 is restored, a path is completed from the winding of the shift release relay 76 through lead 236 and through the break contacts 237 of relay AR4, lead 238, to the lead 210 and the make contact of advance relay 99. When the first marking signal is received for the succeeding letter or figure, the advance relay 99 will operate and apply a positive potential to operate the shift release relay 76 momentarily over the path just described. The operation of the shift release relay 76 will remove from its break contact the positive holding or locking potential for the shift relay 75, thus causing shift relay 75 to become de-energized, as a result of which armature S1 of shift release relay 75 will again engage break contact 313 and close a path to the letter solenoid 73, simultaneously breaking the circuit to the figure solenoid 72. The restoration of shift relay 75 to normal will also cause armature S2 of this relay to disengage make contact 318 and to engage contact 317. When the minus 120 volts is re-applied to make contact 317, there is a negative pulse applied to lead 74 extending to the shift trigger circuit 108. This negative pulse on lead 74 is differentiated by condenser C22 and resistor R22 and fires or activates shift trigger 108 to cause pentodes 70 and 71 to pass current, as a result of which a circuit is completed through the space path of these pentode tubes, switch S1 and make contact 313, and lead 312 to operate the letter solenoid 73, thus restoring the circuit to the letters or lower case position. The circuit is now ready to receive another code combination of Morse code signals.

The operation of the shift mechanism is graphically illustrated in Fig. 4 wherein line 23 indicates, by way of example, a Morse code combination for the numeral 5 followed by the letter E. The pulses of positive polarity shown in line 23 are produced by the operation of the advance relay 99 which operates for every marking signal. It should be noted from line 24 of Fig. 4 that relay AR4 operates at the beginning of the fifth marking signal and remains closed until the operation of the clear relay 117 as indicated in line 25. The clear relay 117 operates following the operation of the printing solenoid 56 as shown in line 29. Line 26 of Fig. 4 indicates that the shift relay 75 operates substantially simultaneously with and from the operation of relay AR4. The shift relay 75 releases upon the first operation thereafter of the shift release relay 76 as indicated in line 27 of Fig. 4. It should be noted from line 27, that the shift release relay 76 operates at the beginning of each marking signal of line 23 so long as the relay AR4 is unoperated. The wave form of line 28 of Fig. 4 represents the current in the figure solenoid 72 and shows that the figure solenoid 72 operates upon the operation of the shift relay 75. The wave form of line 29 represents the current in the printing solenoid 56 for the particular figure or letter selected, and this printing solenoid operates after the operation of the figure solenoid 72; that is, after one and one half bauds of spacing signal. The wave form of line 30 represents the operation of the letter solenoid 73. It should be noted that the letter solenoid 73 operates upon the release of shift relay 75 which corresponds in time position with the start of the next marking signal following the numeral code combination. The operation of the figure solenoid 72, the printing solenoid 56 and the letter solenoid 73 must follow one another, as shown in lines 28, 29 and 30, and no two of these solenoids should overlap at any time in operation. Line 29 shows that the second operation of the printing solenoid 56 for the letter E follows the operation of the letter solenoid 73.

It should be understood that the invention is not limited to the particular polarities of the potentials shown for operating and locking the relay chains and operating the trigger circuits, since, it will be obvious that by suitable design of the circuit, other potentials may be used to operate and lock up the relays and other potentials can be used to operate the trigger circuits by applying suitable impulses to selected tubes of the trigger circuits. Since the advance relay 99 and the relays AR1 through AR5 function as stepping relays, it will be appreciated that these relays can be replaced by a single stepping relay having a plurality of wiping contacts.

Since the solenoids 56 are mechanical means for actuating the key levers of a perforator or a typewriter or other suitable transcribing devices, it will be evident that the final utilization circuit operated by the solenoids 56 may be either a five-unit, six-unit, seven-unit or other multi-unit printing tape perforating machine.

In summation, the system of the invention receives continental Morse code signals, sorts out dots and dashes and spaces by electronic circuits, and utilizes the outputs of these electronic circuits for operating a relay chain which controls the selection of solenoids for transcribing the received Morse code signals into another code.

What is claimed is:

1. A circuit arrangement for discriminating between code elements of different time durations in apparatus for translating code signals, including a first self-restoring electron discharge device trigger circuit operatively responsive to the start of every mark element, a second self-restoring electron discharge device trigger circuit coupled to and under control of said first trigger circuit and operatively responsive to the trailing

edge of a mark element whose duration is less than the active time of said first trigger circuit, and a third self-restoring electron discharge device trigger circuit under control of said first trigger circuit and operatively responsive to the trailing edge of a mark element whose duration is longer than the active time of said first trigger circuit.

2. A circuit arrangement for discriminating between dots, dashes and spaces of predetermined code signals, said dots and dashes comprising mark elements of different time durations, including a marking electron discharge device trigger circuit operatively responsive to the start of every mark element and having an active time longer than the duration of a dot, a dot electron discharge device trigger circuit coupled to and under control of said marking trigger circuit and operatively responsive to the end of a mark element whose duration is less than the active time of said marking trigger circuit, and a dash electron discharge device trigger circuit coupled to and under control of said marking trigger circuit and operatively responsive to the end of a mark element whose duration is longer than the active time of said marking trigger circuit.

3. A circuit arrangement for discriminating between dots, dashes and spaces of predetermined code signals, said dots and dashes comprising mark elements of different time durations, including an input circuit to which said signals are applied and coupled thereto a marking electron discharge device trigger circuit operatively responsive to the start of every mark element, and having an active time longer than the duration of a dot, a dot electron discharge device trigger circuit coupled to and under control of said marking trigger circuit and operatively responsive to the end of a mark element whose duration is less than the active time of said marking trigger circuit, a dash electron discharge device trigger circuit coupled to and under control of said marking trigger circuit and operatively responsive to the end of a mark element whose duration is longer than the active time of said marking trigger circuit, an output circuit coupled to said dot trigger to deliver signals corresponding to said dots and another output circuit coupled to said dash trigger to deliver signals corresponding to said dashes.

4. Apparatus for converting Morse code signals utilizing dots, dashes and spaces for the code combinations to other code signals, said dots and dashes comprising mark characters of different time durations, including a marking trigger circuit responsive to the start of every mark character, and having an active time longer than the duration of a dot, said marking trigger circuit including a pair of grid-controlled electron discharge devices whose anodes and grids are inter-connected regeneratively, one device being normally conductive and the other device normally non-conductive in the stable state and vice-versa in the active state of said trigger circuit, a pair of electric tubes each having an anode, a cathode and a grid, a connection from the anode of the normally non-conductive device of said trigger circuit to the grid of one electric tube, a connection from the anode of the normally conductive device of said trigger circuit to the grid of the other electric tube, a diode shunted by a condenser in the cathode circuit of each electric tube, whereby said electric tubes are alternately conductive, one being conductive in the stable state of said trigger circuit and the other being conductive in the active state of said trigger circuit, a dot trigger circuit connected to the cathode of that electric tube associated with said normally non-conductive device, a dash trigger circuit connected to the cathode of that electric tube associated with said normally conductive device, and means for supplying negative impulse to said dot and dash trigger circuits at the end of every mark character.

5. A circuit arrangement for discriminating between elements differing in time duration of prearranged code signals, said code having mark elements and interposed space elments arranged in combination to correspond to individual characters of said code, inter-element spaces being of given duration, inter-character spaces being of another duration, and the word space being still a different time duration, including a circuit to which said code signals are applied, and coupled thereto a first self-restoring trigger circuit having a stable and an active state and responsive to the end of a mark element, a second self-restoring trigger circuit coupled to and responsive to the restoration of said first trigger circuit, said second trigger circuit having an active time duration which is longer than that of said first trigger circuit, a third self-restoring trigger circuit having a pair of connections coupling the same to said second trigger circuit and being responsive to both the activation and restoration of said second trigger circuit, and means to prevent the operation of both said second and third trigger circuits during the presence of a mark element.

6. Apparatus for identifying the character of the space of a continental Morse code signal, comprising a first self-restoring trigger circuit having a stable state and an active state, the active time of said trigger circuit being substantially 1½ bauds, a circuit to which said Morse code signals are adapted to be supplied, means coupled to said circuit and operative in response to signals therein for tripping said trigger circuit from its stable to its active state at the beginning of a space, a second self-restoring trigger circuit coupled to and responsive to the restoration of said first trigger circuit, the active time of said second trigger circuit being substantially 2½ bauds, a third self-restoring trigger circuit coupled to and responsive to the tripping and restoration of said second trigger circuit, means to prevent the tripping of either said second or third trigger circuits during the presence of a mark signal, and an indicating circuit coupled to the output of said third trigger circuit.

7. In combination, a first self-restoring trigger circuit having a pair of output connections, second and third self-restoring trigger circuits, electronic means between one of said output connections and said second trigger circuit for conditioning said second trigger circuit to operate, electronic means between said other output connection and said third trigger circuit for conditioning said third trigger circuit to operate, said two electronic means being alternatively conductive, a pulse input circuit for supplying to said first trigger circuit a pulse of such polarity and magnitude as to trip said first trigger circuit at the start of said last pulse, and individual differentiator circuits coupling said second and third trigger circuits to said pulse input circuit for supplying to said last trigger circuits impulses at the end of said pulse of such polarity and magnitude as to trip only that second or third trigger

circuit which is conditioned to operate by its associated means.

8. Apparatus for converting Morse code signals having mark and space characters for every code combination to other code signals, including a first self-restoring trigger circuit responsive to the start of every mark element, a second self-restoring trigger circuit under control of said first trigger circuit and responsive to the trailing edge of a mark element whose duration is less than the active time of said first trigger circuit, and a third self-restoring trigger circuit under control of said first trigger circuit and responsive to the trailing edge of a mark element whose duration is longer than the active time of said first trigger circuit, a fourth self-restoring trigger circuit having a stable and an active state and which is responsive to the end of a mark element, a fifth self-restoring trigger circuit coupled to and responsive to the restoration of said fourth trigger circuit, said fifth trigger circuit having an active time duration which is longer than that of said fourth trigger circuit, and a sixth self-restoring trigger circuit having a pair of input connections extending to the outputs of said sixth trigger circuit for enabling the tripping of said fifth trigger circuit at both the activation and restoration of said fifth trigger circuit, and means to prevent the activation of both said fifth and sixth trigger circuits during the presence of a mark element.

9. Apparatus for converting Morse code signals having mark and space elements for every code combination to other code signals, including a first self-restoring trigger circuit responsive to the start of every mark element, a second self-restoring trigger circuit under control of said first trigger circuit and responsive to the trailing edge of a mark element whose duration is less than the active time of said first trigger circuit, and a third self-restoring trigger circuit under control of said first trigger circuit and responsive to the trailing edge of a mark element whose duration is longer than the active time of said first trigger circuit, a fourth self-restoring trigger circuit having a stable and an active state and which is responsive to the end of a mark element, a fifth self-restoring trigger circuit coupled to and responsive to the restoration of said fourth trigger circuit, said fifth trigger circuit having an active time duration which is longer than that of said fourth trigger circuit, and a sixth self-restoring trigger circuit having a pair of input connections extending to the outputs of said fifth trigger circuit for enabling the tripping of said sixth trigger circuit at both the activation and restoration of said fifth trigger circuit, and means to prevent the activation of both said fifth and sixth trigger circuits during the presence of a mark element, a relay chain under control of said second and third trigger circuits, a plurality of solenoids whose operating paths are controlled by the setting of said relay chain, and means for operating the selected solenoid under control of said sixth trigger circuit.

10. Apparatus for converting Morse code signals utilizing dots, dashes and spaces for the code combinations to other code signals said dots and dashes comprising mark elements of different time duration, including a marking trigger circuit responsive to the start of every mark element and having an active time longer than the duration of a dot, a dot trigger circuit under control of said marking trigger circuit and responsive to the end of a mark element whose duration is less than the active time of said marking trigger circuit, a dash trigger circuit under control of said marking trigger circuit and responsive to the end of a mark element whose duration is longer than the active time of said marking trigger circuit, a chain of relays under control of said dot and dash trigger circuits, and a stepping relay operative at the start of each dot and dash for advancing the operation of the relays in said chain.

11. Electronic apparatus for sorting spaced dot and dash mark elements of a code signal, comprising an input circuit upon which is impressed dot and dash D. C. signals, a first amplifier and inverter tube coupled to said input circuit, a second amplifier and inverter tube coupled to the output of said first tube, a first self-restoring trigger circuit having a pair of output connections, second and third self-restoring trigger circuits, means between one of said output connections and said second trigger circuit for conditioning said second trigger circuit to operate, means between said other output connection and said third trigger circuit for conditioning said third trigger circuit to operate, said last two means being alternatively conductive, a connection including a differentiator circuit from the output of said second tube to the input of said first trigger circuit for tripping the same at the start of a mark element, and individual differentiator circuits coupling the output of said first tube to said second and third trigger circuits for tripping only that second or third trigger circuit which is conditioned to operate by its associated means.

12. Morse code signal converting apparatus comprising a chain of dot and dash electromagnetic relays, a plurality of solenoids whose operating paths are under control of the contacts of said relays, means including electronic discharge device circuits for operating a dot relay in said chain when a dot signal is received, means including electronic discharge circuits for operating a dash relay in said chain when a dash signal is received, means responsive to the operation of said dot and dash relays for advancing the operation of the relays in said chain, electronic discharge device circuits for separating spaces of different durations to thereby distinguish between inter-element spaces and inter-character and inter-word spaces, and connections for operating a selected solenoid by said last electronic discharge device circuits at the end of every character signal code combination and word signal code combination.

13. Morse code signal converting apparatus comprising a chain of dot and dash electromagnetic relays, a plurality of solenoids whose operating paths are under control of the contacts of said relays, means including electronic discharge device circuits for operating a dot relay in said chain when a dot signal is received, means including electronic discharge device circuits for operating a dash relay in said chain when a dash signal is received, means responsive to the operation of said dot and dash relays for advancing the operation of the relays in said chain, electronic discharge device circuits for separating spaces of different durations to thereby distinguish between inter-element spaces and inter-character and inter-word spaces, connections operating a selected solenoid by said last electronic discharge device circuits at the end of every character signal code combination and word signal

code combination, and means operative subsequent to the operation of a selected solenoid for resetting the chain of relays to normal in readiness for operation in response to another code combination.

14. Apparatus for converting Morse code signals having mark and space elements for every code combination to other code signals, including a first self-restoring trigger circuit responsive to the start of every mark element, a second self-restoring trigger circuit under control of said first trigger circuit and responsive to the trailing edge of a mark element whose duration is less than the active time of said first trigger circuit, and a third self-restoring trigger circuit under control of said first trigger circuit and responsive to the trailing edge of a mark element whose duration is longer than the active time of said first trigger circuit, a fourth self-restoring trigger circuit having a stable and an active state and which is responsive to the end of a mark element, a fifth self-restoring trigger circuit coupled to and responsive to the restoration of said fourth trigger circuit, said fifth trigger circuit having an active time duration which is longer than that of said fourth trigger circuit, and a sixth self-restoring trigger circuit having a pair of input connections extending to the outputs of said fifth trigger circuit for enabling the tripping of said fifth trigger circuit at both the activation and restoration of said fifth trigger circuit, and means to prevent the activation of both said fifth and sixth trigger circuits during the presence of a mark element, a chain of relays under control of said second and third trigger circuits, a stepping relay operating in response to a mark element for advancing the operation of the relays in said chain, a plurality of solenoids whose operating paths are controlled by the setting of said relay chain, an electronic circuit for operating the selected solenoid in response to the tripping of said sixth trigger circuit, said electronic circuit having its current passing condition momentarily altered by the tripping of said sixth trigger circuit, and means responsive to the restoration to normal of the current passing condition of said electronic circuit for resetting the chain of relays to normal in readiness for operation in response to another signal code combination.

15. An unequal length code telegraph translator for translating code signals utilizing dot marking elements, dash marking elements and spaces for the code combinations, an electronic circuit operatively responsive to received dot marking elements, an electronic circuit operatively responsive to received dash marking elements, a chain of relays under control of said circuits, means responsive to each marking element for advancing the operation of the relays in said chain, one of the relays in said chain being operative only after the receipt of a predetermined plurality of marking elements, a figure or case shift solenoid, and means operative in response to the operation of said one relay for operating said figure or case shift solenoid.

16. An unequal length code telegraph translator for translating code signals utilizing dot marking elements, dash marking elements and spaces for the code combinations, a circuit responsive to received dot marking elements, a circuit responsive to received dash marking elements, a chain of relays under control of said circuits, means responsive to each marking element for advancing the operation of the relays in said chain, one of the relays in said chain being operative only after the receipt of a predetermined plurality of marking elements, a letter solenoid and a figure or case shift solenoid, a shift relay having different contacts connected to said solenoids, connections for operating said shift relay in response to the operation of said one relay in said chain, to thereby operate said figure or case shift solenoid, and a circuit for operating said letters solenoid when said shift relay is restored to normal.

17. An unequal length code telegraph translator for translating code signals utilizing dot marking elements, dash marking elements and spaces for the code combinations, means including a dot trigger circuit responsive to received dot marking elements, means including a dash trigger circuit responsive to received dash marking elements, a chain of relays under control of said dot and dash trigger circuits, a stepping relay operative at the start of each marking element for advancing the operation of the relays in said chain, one of the relays in said chain being operative after the receipt of a predetermined plurality of marking elements, a case shift relay operative in response to the operation of said one relay in said chain, a figure or case shift solenoid, and means for operating said solenoid in response to the operation of said case shift relay.

18. A circuit arrangement for discriminating between code elements of different time duration in apparatus for translating code signals, including a first self-restoring electron discharge device trigger circuit operatively responsive to the start of every mark element, a second self-restoring electron discharge device trigger circuit coupled to and under control of said first trigger circuit and operatively responsive to the trailing edge of a mark element whose duration is less than the active time of said first trigger circuit, and a third self-restoring electron discharge device trigger circuit under control of said first trigger circuit and operatively responsive to the trailing edge of a mark element whose duration is longer than the active time of said first trigger circuit, each of said trigger circuits comprising a pair of electrode structures having anode and grid electrodes and cross-connections interconnecting the grid and anode electrodes regeneratively, and resistor and condenser elements of predetermined values in circuit with said electrodes for determining the active time of the trigger circuit.

19. In combination, a first self-restoring trigger circuit comprising a pair of vacuum tubes having anode and grid electrodes cross-coupled regeneratively, an electron discharge device having a grid connected over a direct current path to the anode of one tube of said pair and having a cathode coupled to ground through a condenser shunted by a rectifier, another electron discharge device having a grid connected over a different direct current path to the anode of said other tube of said pair and having a cathode coupled to ground through a condenser shunted by a rectifier, second and third self-restoring trigger circuits coupled to different cathodes of said electron discharge devices, a pulse input circuit, means including a differentiator circuit coupled to said input circuit for supplying to said first trigger circuit impulses of such polarity and magnitude as to trip said first trigger circuit at the start of a pulse in said input circuit, and additional individual differentiator circuits coupling said input circuit to said second and third self-restoring trigger circuits for supplying tripping impulses

thereto at the end of a pulse in said input circuit.

20. A circuit arrangement for discriminating between characters of prearranged code signals differing in the total number of individual marking elements, comprising a first solenoid to be operated upon receipt of characters having less than a predetermined number of individual marking elements, a second solenoid to be operated upon receipt of characters having said predetermined number of individual marking elements, means to actuate said second solenoid upon receipt of a marking element of ordinal number equal to said given number of the code character under consideration, and means responsive to the first marking element in the succeeding code character to actuate said first solenoid.

21. A circuit arrangement for discriminating between characters of prearranged code signals differing in the total number of individual marking elements, comprising a first solenoid to be operated upon receipt of characters having less than a predetermined number of individual marking elements, a second solenoid to be operated upon receipt of characters having said predetermined number of individual marking elements, a relay chain arranged for successive operation of the relays therein upon receipt of the individual marking elements of the character under consideration, a shift relay responsive to the relay in said chain of ordinal number equal to said given number of the code character under consideration to actuate said second solenoid, and a trigger circuit coupled to said shift relay to actuate said first solenoid in response to the first marking element in the succeeding code character.

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