

July 8, 1969

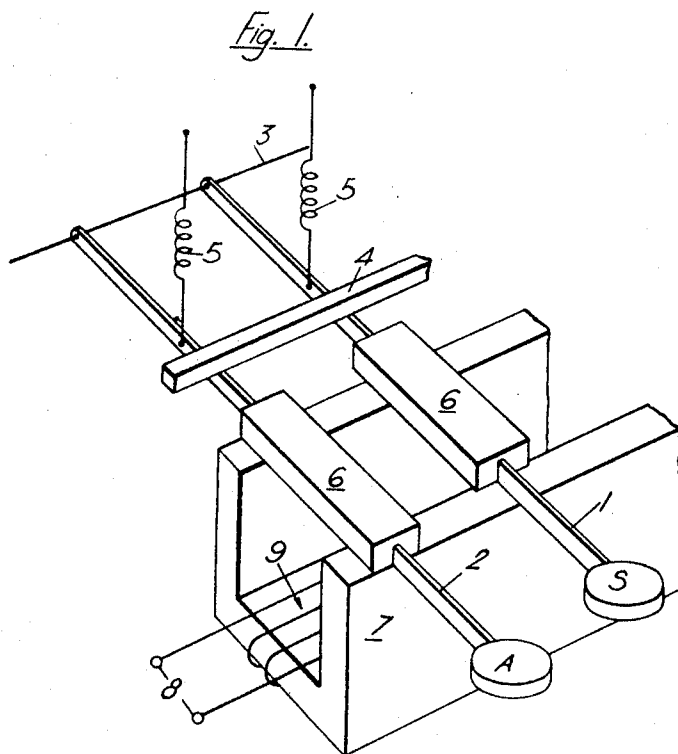
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CODE GENERATING KEYBOARD APPARATUS

Filed May 17, 1966

Sheet 1 of 2



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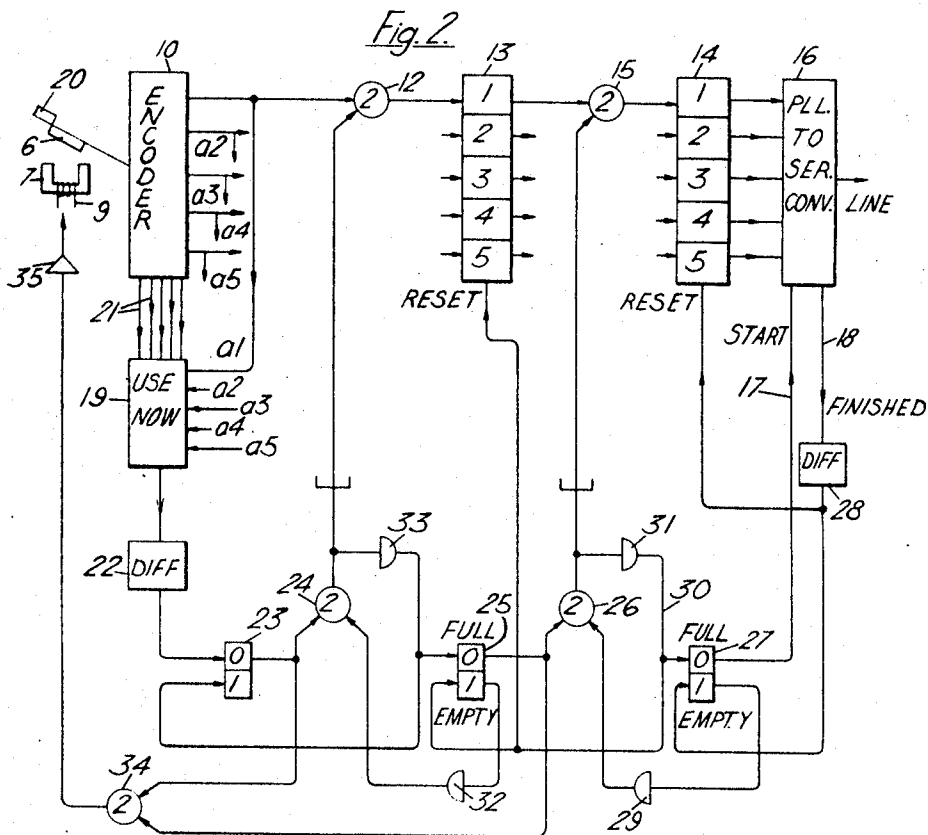
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CODE GENERATING KEYBOARD APPARATUS
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Filed May 17, 1966, Ser. No. 550,859

Claims priority, application Great Britain, June 18, 1965,
25,871/65

Int. Cl. H04I 15/12

U.S. Cl. 178—17.5

7 Claims

ABSTRACT OF THE DISCLOSURE

In keyboard apparatus where depression of a key generates a code signal in parallel mode and the apparatus must provide a serial mode output, the input may be faster than the speed of code conversion. It is therefore normal to provide a queuing store interposed between the key-operated encoder and the subsequent parallel-to-serial mode converter, however according to the invention, a further stage of storage is provided so that when the queuing store is full and a key is depressed, the key is retained in its depressed condition until the queuing store is able to accept its code, when transfer occurs and the key is released.

The invention relates to code-generating keyboard apparatus and is concerned with depressed key retention arrangements.

In certain types of code-generating keyboard apparatus the possibility arises that a typist may depress a key while the apparatus is still handling the code signals generated by a previous key depression. This is particularly the case where key depression causes generation of code signals in a parallel mode and they have to be converted into a serial mode.

According to the present invention there is provided code-generating keyboard apparatus including a set of keys to each of which a respective binary code combination is allotted, an encoder arranged for generating the appropriate code combination in parallel mode upon depression of one of the said keys, a parallel to serial mode converter arranged for transmitting a said code combination in serial mode, storage means interposed between the encoder and the converter for holding a said code combination while a previous one is being transmitted, and means, in the event of a further key being depressed while the storage means is occupied so as not to be able to accept a further code combination, for automatically holding the said further key in its depressed condition until the storage means is free to accept its code combination.

An embodiment of the invention will be described with reference to the accompanying drawings in which:

FIG. 1 illustrates diagrammatically part of a preferred arrangement of key bars and a hold-down magnet in apparatus according to the invention, and

FIG. 2 is a logic diagram illustrating a preferred method of control of the hold-down magnet.

In FIG. 1 a pair of keys having respective keybars 1 and 2 parallel to one another are represented as being pivoted on an axis 3 and normally held against a stop 4 by means of respective return springs 5. These two keys are members of a set which extends to the right of the drawing. An electromagnet 7 has a pair of poles extending transversely below the keybars. Each keybar carries an armature 6 bridging the poles of the electromagnet when the key is depressed. The electromagnet may be energised when required by connecting a source of electric current to terminals 8 of a winding 9. It is arranged that the strength of the magnet is such that it will hold

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a keybar whose key has been fully depressed, but will not move any other unoperated key.

In the drawing, keybar 2 is shown in the key-depressed condition with its armature bridging the poles of the magnet and the keybar 1 is shown in its unoperated condition held up by means of its return spring 5. In accordance with common practice with electrical keyboards, means (not shown) are provided for preventing more than one key being depressed at a time. As the electromagnet has only to retain attracted to it an armature which is already bridging its pole pieces, but does not have to pull any armature over a large air gap, the energising current required to keep a key depressed may be quite small. A residual air gap of optimal length is provided to overcome the effect of residual magnetism of the armature.

To permit the keyboard to be operated for short periods at a greater speed than the eventual transmission rate, it is customary to precede the parallel serial code converter with a number of stores, a code combination being transferred from store to store as preceding code combinations are transmitted.

In such an arrangement the store following the encoder has to accept the code combination generated by the depression of the key, but cannot do so if it is still full when a key is depressed. By means of the present invention, however, a depressed key may itself provide a further store for its particular code combination, in that, if the previously mentioned store is full and a key is depressed it is arranged that the key is retained in its depressed condition until the store becomes vacant, when its code combination is transferred to the store and the key is released.

Referring now to FIG. 2, a key 20 is represented in its unoperated condition with its armature 6 over the magnet 7. Depression of the key generates a parallel combination of binary code elements—in the case of a teleprinter, for example, there will be five permutable code elements—and, for present purposes, it may be assumed that these information bits are generated in a key-operated encoder 10 which has a separate outlet for each element of the code combination. Each of these outlets is taken via its own gate 12 to the corresponding inlet of a parallel mode store 13. In the drawing only one of the gates 12 is shown. The store 13 consists of a set of bistable devices, one for each permutable code element, the state of each device being determined by the binary condition (MARK or SPACE) last existing at its input, each device having its own outlet which reflects the condition of the device. Each of the outlets of store 13 is connected to the corresponding inlet of a similar parallel mode store 14 through its own gate 15, again only one of these being shown on the drawing. The outlets of the store 14 are connected to corresponding inlets of a parallel to serial mode converter 16 of known type which will commence to transmit to LINE the serial mode code combination corresponding to its parallel mode input upon receipt of a signal from a lead 17 marked START and which will transmit a pulse to a lead 18 marked on the drawing FINISHED, when the transmission of the code combination has been completed. Suitable converters are well known in the art, and comprise basically, a set of gates opened singly and successively by clock pulses fed to the successive gates by a pulse distributor.

The gates 12 between the encoder 10 and the store 13 are AND gates each providing an output signal when and only when there is a corresponding input from the encoder together with a signal condition indicative that (a) the store 13 is empty and (b) that the key 20 has been fully depressed so as to generate a valid code. The requirement (b) is provided by a USE NOW signal generator 19 which supplies an output only when a complete code combination has been generated by full depression of the

key. The USE NOW device may be of the type wherein depression of a key of the keyboard sets up signal condition (in parallel mode) representative not only of the binary code to be transmitted but also of its complement. In the drawing connections between the encoder and device 19 for the complementary code are indicated at 21 while connections for the code to be transmitted are provided by leads a1 to a5 of which, to avoid complicating the drawing, only a1 is shown in full. An output from device 19 is obtained only when, in respect of each of the five permutable code elements, a signal representative of the element to be transmitted or of its complement is received. An output from device 19 persists so long as a key remains fully depressed, a pulse from the rise of such an output being provided by a differentiator 22 and recorded by a bistable device 23, an output of which provides one input to an AND gate 24 which controls all the AND gates 12 with respect to the conditions (a) and (b) mentioned above.

When the condition (a) that the store 13 is empty is fulfilled, a second input signal to gate 24 is provided from a bistable memory device 25 whose "0" and "1" states as represented on the drawing correspond to store 13 being FULL or EMPTY, respectively. The means for controlling device 25 will be described later.

The gates 15 between the stores 13 and 14 are AND gates each of which provides an output when and only when it is in receipt of an input from its corresponding section of store 13 and, simultaneously, the following two conditions are satisfied: (c) store 13 is full and (d) store 14 is empty. Conditions (c) and (d) are taken care of by an AND gate 26 which provides an output feeding all the gates 15 on receipt of one input signal from memory device 25 indicating that store 13 is full and a second input from another bistable memory device 27 whose "0" and "1" states correspond respectively to store 14 being FULL or EMPTY.

A START signal is applied to lead 17 when device 27 is switched to its "0" state indicative that store 14 is FULL and then the parallel to serial mode converter 16 transmits the stored code to LINE. Meanwhile device 27 remains in its "0" state so that gate 26 and hence all the gates 15 remain closed. When the permutable code elements of the code combination held in store 14 have been transmitted, the converter generates a normal teleprinter "stop" signal which, as mentioned, previously, is applied to lead 18 to indicate that transmission is FINISHED. The "stop" signal is differentiated by a differentiating device 28 to provide a "RESET" signal for resetting store 14 and to switch memory device 27 to its "1" state indicating that store 14 is now EMPTY.

The gate 26 opens only when memory device 27 indicates that store 14 is empty and memory device 25 indicates that a code combination awaiting transmission is held in store 13. To allow time for resetting store 14, the input signal from 25 to 26 is delayed by a delay device 29. Opening of gate 26 applies a signal to all the gates 15, permitting them to be opened. This signal is also applied to a lead 30 after a delay, provided by device 31, sufficient to ensure transfer of the code combination from store 13 to store 14. The signal applied to lead 30 switches the bistable device 27 to "0" and the device 25 to "1," indicating that store 14 is now full and store 13 empty, and at the same time resets store 13. A delay device 32 provides that the input to gate 24 indicative that store 13 is empty does not arrive until store 13 has been reset. As mentioned previously, gate 24 opens when it has one input signal indicating that a complete code combination is held in encoder 10 and a second input signal indicating that store 13 is empty. When these two conditions coincide, gate 24 transmits a signal allowing gates 12 to open and after delay by device 33 for a time sufficient for transfer of the code combination from encoder 10 to store 13, switches device 25 to "0" and device 23 to "1," so closing gate 24 again.

It is desired to hold key 20 down when it is fully depressed and when store 13 is full. Full depression of the key causes generation of a USE NOW signal, as previously described, the occurrence of which switches bistable device 23 into state "0," while memory device 25 registered the condition when store 13 is full. It is arranged, therefore, that magnet 7 shall be energised when both the devices 23 and 25 are simultaneously in their "0" states, output from these devices being fed to the two input terminals of an AND gate 34 whose output, amplified if necessary by amplifier 35 is coupled to winding 9 of the hold down magnet. The key is released by the reclosure of gate 34, which occurs when either of its inputs is removed; normally the first one to be removed will be that from bistable device 25 as the latter is switched from full to empty by the signal which resets store 13. The release time of the magnet 9 will usually be sufficient to allow gates 12 to open and the code combination in encoder 10 to pass through them before the key 20 can be depressed again; if necessary additional delay for release of the key may be provided in amplifier 35, for example.

The key 20 will be held down by the magnet 7 only if store 13 is full. So long as the key is fully depressed, either manually or through retention by magnet 7, the corresponding parallel code combination will continue to be generated by encoder 10 and the USE NOW signal will persist. The differentiator 22, however, causes only a transient signal to be sent to device 23, so that gate 24 is not reopened after the receipt of the code combination by store 13 until another USE NOW signal is generated even though store 13 empties before key 20 is released. Thus the code combination is not retransmitted. Should it be desired to transmit the same code combination successively by holding a key down, it may be arranged, by means not shown, to interrupt the encoder or the USE NOW signal generator momentarily at a given time after completion of transmission to LINE of each successive code combination. After each such interruption a new USE NOW signal will be generated and a pulse will be fed to device 23 to unlock gate 24.

It is considered unnecessary to recite the complete sequence of operations which ensue upon depression of key 20 in the presence of the different possible initial states of the arrangement of FIG. 2. It will be seen that if key 20 be depressed while store 13 is still full, the key will be held down until store 13 empties and then the code combination of the key is passed to store 13 and the key is released. In the absence of special provisions for repeatedly transmitting the same code combination, a complete code combination can be transmitted to LINE only once for each depression of the key.

The basic arrangement of FIG. 2 permits of several modifications which will occur to those skilled in the art. In particular further binary stores may be inserted between the stores 13 and 14 to provide additional storage, should this be desired; on the other hand, for some applications, only one store between the encoder and the parallel to serial mode converter may suffice, in which case, referring to FIG. 2, the store 13, the gates 12, the gate 24, the bistable device 25, and the delay devices 32 and 33 would all be omitted, the output of bistable device 23 providing one input for gate 26 and one input for gate 34, while the other input for gate 34 would be fed from lead 17.

I claim:

1. Code generating keyboard apparatus comprising:
 - a set of keys to each of which a respective binary code combination is allotted;
 - an encoder arranged for generating the appropriate code combination in parallel mode upon depression of one of the said keys and for holding the code combination generated therein while a key remains fully depressed;
 - a parallel to serial mode converter arranged for transmitting a said code combination in serial mode;

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a storage means including a parallel mode code store interposed between the encoder and the converter for holding a said code combination while a previous one is transmitted;

an electromagnet which, in the event of a further key being depressed while the storage means is occupied so that it cannot accept another combination, automatically holds the said further key in its depressed condition until the storage means is free;

gating means allowing transfer of a code combination from the encoder to the code store;

means for opening the gating means when and only when the store is empty and, at the same time, a complete code combination is held in the encoder;

means for energizing the electromagnet when the store is full, and, at the same time, a complete code combination awaiting transfer to the store is held in the encoder; and

a signal generator arranged to furnish an output signal when a valid code combination has been set up in the encoder in response to full depression of one of said keys.

2. Apparatus as claimed in claim 1 including a first bistable device, means for setting it into a first one of its stable states on receipt of a signal indicating that the code store is able to accept a fresh code combination, a second bistable device and means for setting it into a first one of its stable state in response to the encoding of a complete code combination by the encoder, and an AND gate arranged to provide an output opening the gating means when both the said bistable devices are in their first stable states.

3. Apparatus as claimed in claim 2 including connections from the said AND gate for resetting the bistable devices into their respective second stable states after the gating mean has allowed transfer of the code combination to the code store.

4. Apparatus as claimed in claim 3 including a second AND gate which is arranged to provide an output for energizing the electromagnet when it is supplied with respective inputs responsive to the first bistable device

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being in its second stable state and the second bistable device being in its first stable state.

5. Apparatus according to claim 4 including a further parallel mode code store intermediate the first mentioned code store and the parallel to serial mode converter, gating means between the two code stores allowing transfer of a code combination to the further code store and means for opening the last mentioned gating means when and only when the first mentioned code store is full and the further code store is empty.

6. Apparatus as claimed in claim 5 wherein the means for opening the last mentioned gating means includes a further bistable device, connections thereto for setting it into its respective stable states in accordance with whether the further store is full or empty, and a further AND gate arranged to provide an output opening the said further gating means when and only when the first mentioned code store is full and the said further code store is empty.

7. Apparatus according to claim 1 wherein the keys of the keyboard include a set of parallel keybars, one for each key, said electromagnet having two poles cooperating with a set of armatures each of which is attached to one of the keybars, the two poles of the electromagnet extend transversely below the keybars and each armature being mounted to bridge the two pole pieces when its key is depressed.

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U.S. Cl. X.R.

178—17; 197—107; 235—27; 340—147